AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

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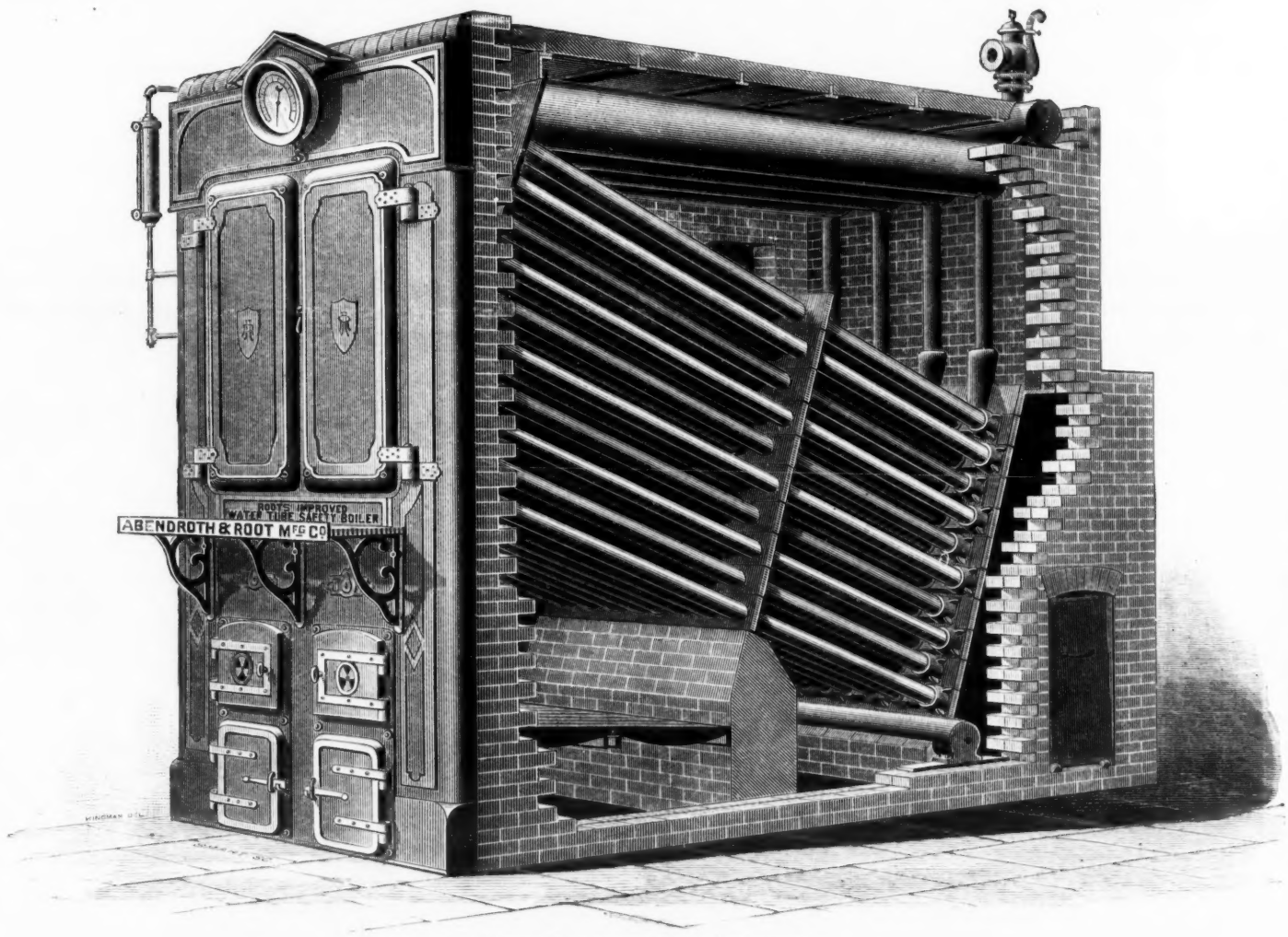
Safety Boiler for High Pressures.

In our issue of Feb. 2, 1884, we illustrated and described the construction of Root's new safety steam boiler, giving in considerable detail what was at that time the latest form of construction adopted by the manufacturers. Shortly after placing this boiler on the market, the manufacturers were applied to for a boiler combining, in a greater degree than this, the three requisites of large power in small space, safety under high steam pressure (250 lbs.) and ability to furnish dry or slightly superheated steam. To secure this order, and with a view to the incorporation of improvements of a general character, competent engineers were employed to revise the details, the result being shown in the present engravings, pages 1, 2 and 3. This is known as the "C" boiler; to those who are acquainted with the former arrangement of this boiler, or who will refer to our previous illustration, the marked changes in construction will be apparent.



SAFETY BOILER FOR HIGH PRESSURES.

In this boiler (see page 3) the water is ordinarily carried at the center of the drums instead of below the drums as in the former construction. This gives a large surface for the quiet liberation of steam. With the water thus carried, we are informed that when the boiler is being worked at its rated capacity, a thermometer inserted in a mercury well in the cross steam-pipe, shows 4° Fahr. superheat. If it is desirable to increase the superheat, the water may be carried at any point down to several feet below the drums. We believe, however, that for all ordinary purposes, the best economical results will be found to obtain with the water level at or near the center of the drums, giving an increased body of water under heat, and increased water surface to be acted upon by heat. The fact, however, that so great a difference in the water level may be had is important as providing for obtaining wide variation in the degree of superheat, and is also to some extent an addititional element of safety.

The Abendroth & Root Manufacturing Co., 28 Cliff street, New York, have made the manufacture of these boilers a special branch of their business, in charge of competent mechanical engineers. So far as we have been able to observe, the changes in detail appear to be most decided improvements, and the workmanship is in every way creditable. Several of the new boilers are already in use.

Main Reciprocating Parts of High-speed Engines.

BY W. H. HOFFMAN.

I think that *solid* pistons with a thickness equal to their diameter, and crossheads increased in size to enormous proportions for high-speed engines, have been abandoned, as the reciprocating fly-wheel had a very decided moralizing effect on the machine in general. I do not believe in the practice of making a piston purposely weak or light, that it may be broken in case of a sudden charge of water from a boiler or condenser, as the cylinder-heads are the points at which to make this allowance. A piston costs more than a cylinder-head, and then, again, after a piston is well surfaced to the cylinder, it should not be purposely broken. Some builders have made the crosshead the point of relief, but, as I have examined the engines and engine-rooms where these crossheads have parted company with their other connections, I do not think I should adopt that plan.

A steam-piston on any engine needs only enough thickness to withstand the initial steam pressure without springing; but when this load is calculated, and it is known that this sudden stress is resisted only at its center by a rod one-seventh of the piston diameter, it will be found that no piston can be made less than $\frac{38}{160}$ of its own diameter up to a diameter of 24″. Of course, the piston must be made adjustable to the cylinder's center, and pistons above 24″ diameter need not be more than $\frac{33}{100}$ of the piston's diameter in thickness, as the initial pressure is rarely above 80 pounds per square inch on the large sizes. The piston, with a bull-ring fitted between the piston-head proper and a follower, being adjustable by set-screws, and having in its face, *sprung in*, two narrow packing rings, is a simple and effective one.

The piston-head should be shrunk on the rod, with a safety nut on the end of the rod covered by the follower, and locked to place by it. If the piston-rod is of steel, and is one-seventh the diameter of cylinder, it is safe for pressures up to 125 pounds. The rods must be hammered in *all* cases, and in finishing it all square shoulders or corners should be avoided, and, if keyed to the crosshead, the edges of the key should be circular. The threaded rod, screwed and clamped to crosshead, is a good method, as it gives a chance to divide the piston clearance in the cylinder, as the connecting-rod boxes are taken up for wear. The threading of the rod, however, weakens it more than a key, and it should be enlarged when this style is adopted.

Some years ago I described and illustrated in the AMERICAN MACHINIST the principal parts in detail of a high-speed engine, and at that time I stated that we had yet to find a better crosshead than that fitted to the four guide-bars (usually called the locomotive style), and I have had no reason to change my mind, even after building nearly a hundred high-speed engines. Since then I have increased the length of the crosshead, where it travels in the guide-bars, much to the advantage of the latter in durability.

The tendency of a crosshead to rock on its bearings, from the vibrating action of the connecting-rod, is well known. I therefore increased the length of the crosshead jaw until this action was balanced by surface, and found that a length of jaw equal to two-thirds of the engine's stroke would keep the surface of the crosshead and bars in perfect form.

Although my style of crosshead pin, made of steel and dovetailed into crosshead, is somewhat expensive, yet I still think it is one of the best designs, as it can be removed and re-turned and ground when necessary; besides this, the pin always presents a perfect alignment, and is the strongest form known.

The wearing surfaces of the crosshead, where they run on the guide-bars, should be of the best babbitt-metal, cast and hammered into crosshead before planing, care being taken that the metal on the top and bottom sides meets at the center in casting, holes being provided for this purpose. By following this course, the metal can never work loose. Cast-iron guide bars are cheap and durable, though those of steel will wear longer, but there is not enough difference in the life of the bars to warrant the extra expense. Should the bars become badly cut, they can easily be removed, planed and surfaced to their condition when new. As for adjustment, there is nothing to equal the four separate guide-bars, and I would make vertical as well as horizontal engines on this plan for stationary purposes, but they would not be exactly convenient for marine service.

The crosshead end of the connecting-rod, for convenience, must have a strap, gib and key, the strap having a safety bolt passing through the butt of the rod. The crosshead pin should be seven-tenths the diameter of the crank-pin, the length being the same as the crank-pin, and the top and bottom sides of the pin should be flatted for about one-fifteenth of its circumference at each place, the boxes in the rod being cut out to match. This will prevent the pin from shouldering,

and allow a liberal amount of oil-chamber at this important point. A pin thus constructed requires little attention even at excessive high speeds.

In my late communications on self-contained high-speed engines, I have endeavored to give the readers of the AMERICAN MACHINIST the results of my experience with this class of motor, not with the idea that I am imparting a wonderful amount of information, but simply to lay a few facts before them, and by so doing, invite a discussion on what I consider very important points in the manufacture of the steam-engine of to-day. One of the greatest sources of economy in a heat or steam motor is *compactness*. There may be some lack of knowledge on steam-cylinder condensation, but we know more about this matter than we did twenty years ago, for we are sure that even with our present moderately high speeds, the loss from this source is much greater than we wish it was, though we have made great improvements in this direction by *high rotative speed*, thus reducing the cylinder surfaces. The question now is: Can we still go forward with the compact system, increasing the speed by perfecting the engine in design and workmanship? I believe this can be done.

Plunger Pumps.

By JAMES F. HOBART.

AIR IN THE PUMP—SMALL PETCOCKS—COMPRESSING AIR—HIGH LIFTS AGAINST BOILER PRESSURE—CHURNING AIR—LEAKY PACKING—USING TWO PUMPS—WATER PACKING—STIFFENING LONG CONNECTING-RODS.

Plunger pumps, especially those of the power variety, sometimes fail to draw water when the draft is considerable, and the reason for such failure is often hard to find.

A certain pump refused to work and after much search the cause of failure was found to be a "blow-hole" in the bottom of the plunger. As long as the hollow plunger was kept filled with water, the leaking of air through the "blow-hole" was prevented, and the pump worked well.

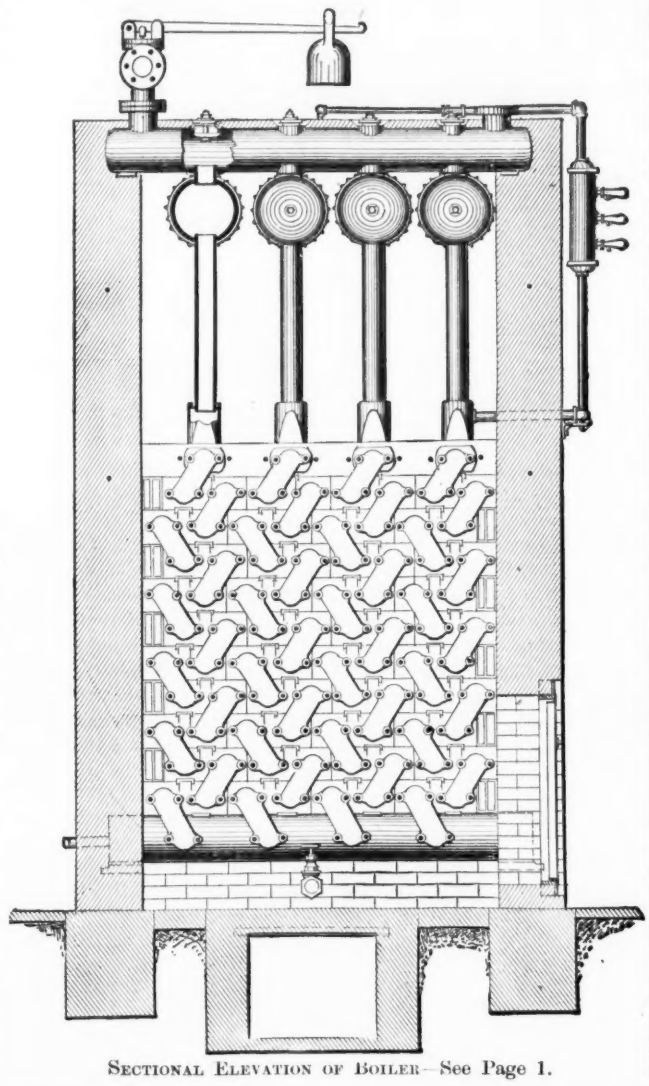
Another case from actual practice was a pump wherein the connecting-rod was attached to the plunger by a split eye-bolt, which passed through the bottom of the plunger and was fastened by a nut beneath. Air leaked through between the bolt and plunger. It was prevented by putting a soft gum washer under the nut which, when screwed hard down, effectually prevented air from entering.

Still another leak is sometimes caused by poor fitting of the pet-cock in the barrel of the pump.

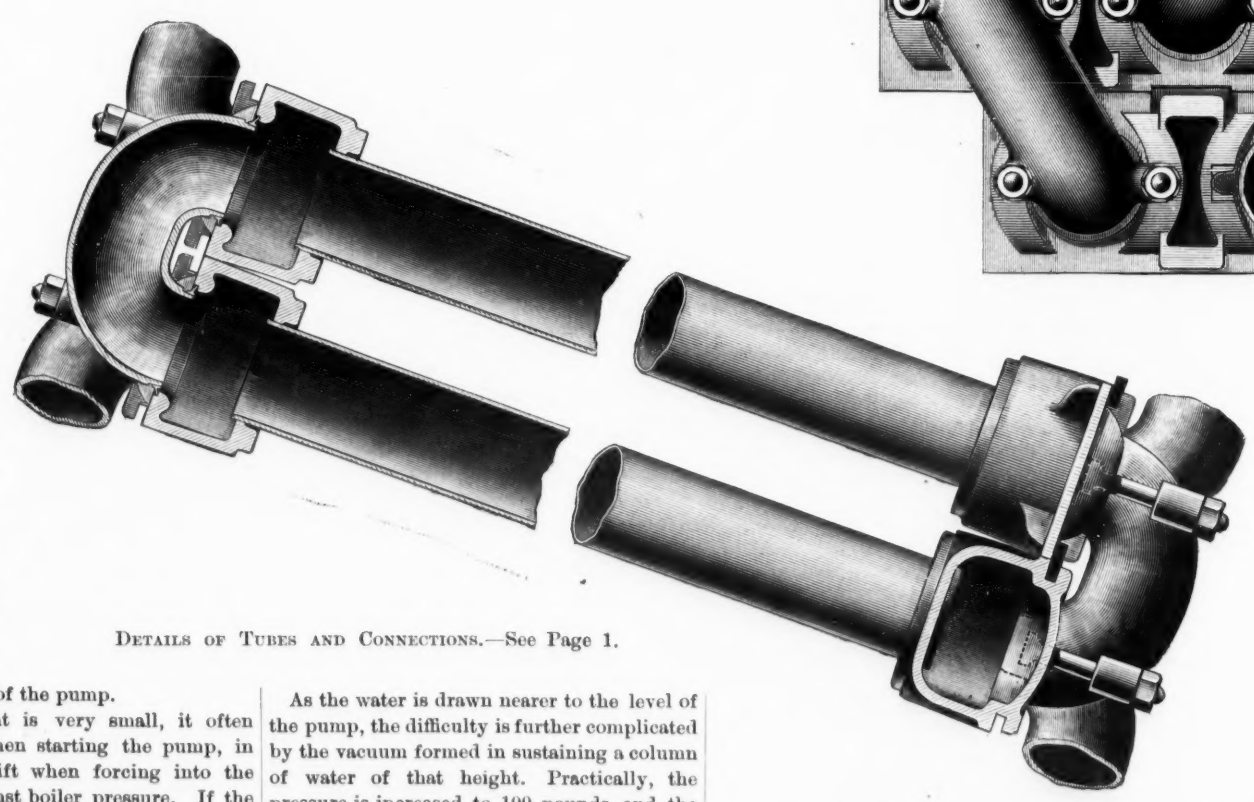
When this vent is very small, it often causes trouble when starting the pump, in case of a high lift when forcing into the delivery pipe against boiler pressure. If the pump has considerable clearance, this trouble will be especially marked. If we have a plunger 4′ in diameter, 8″ stroke, the displacement of that plunger is equal to about 100 cubic inches. If the diameter of the pump barrel be 6″, leaving 1″ of space all around the plunger below the stuffing box, then there is about 124 cubic inches of clearance in the barrel of the pump, counting only that part through which the plunger works, and disregarding the clearance in the valve chambers and lower portion of the pump. We will assume that the lower portion of the pump is filled with water which eliminates this part of the clearance as far as its effect on the suction is concerned. We will also assume that there are 124 cubic inches of air confined in the pump when we start it up, and that there are no leaks whatever in any portion of the pump or fittings.

Calling the draft 20 feet, the up-stroke of the plunger rarefies the air in the draft pipe to a slight extent and sucks nearly 100 cubic inches more air into the barrel, making a total of about 224.

The down-stroke of the plunger must compress this air until it exerts a pressure equal to that of the steam in the boiler, or, we will assume, about 90 pounds above atmospheric pressure. From one of Nystrom's tables, we deduce that a body of air compressed with a pressure of about 90 pounds above that of the atmosphere will be reduced to one-third of its original volume. With the amount of clearance in the above pump, the air can only be reduced to about three-fifths of its original volume, and consequently the pump will never be able to fill itself with water until an opening is made into the atmosphere either by the vent-cock or (a much better way) an independent overflow, directly open to the atmosphere and fitted with check and stop valves.



SECTIONAL ELEVATION OF BOILER.—See Page 1.



DETAILS OF TUBES AND CONNECTIONS.—See Page 1.

As the water is drawn nearer to the level of the pump, the difficulty is further complicated by the vacuum formed in sustaining a column of water of that height. Practically, the pressure is increased to 100 pounds, and the clearance in the pump must be still further reduced to about one-fourth the volume of the plunger. By the above, we can see the necessity of expelling about all the air from a pump which is to work as described.

The common method of getting rid of the air, is to hold a finger lightly over the open vent-cock of the pump barrel. As the plunger descends, air is expelled. As the plunger rises, air is prevented from entering by the finger, which is forced tight upon the end of the pet-cock by the partial vacuum formed in the pump barrel, and thus the finger in connection with the vent-cock, forms a check-valve.

In many cases the vent-cock is placed so near the bottom of the pump barrel, that it is unable to discharge the required per cent. of air necessary to reduce the volume to such a quantity that it can be compressed to the requisite pressure, therefore the pump can "churn" its contained air all day without the slightest possibility of its "getting hold" of the water in the draft-pipe.

In the case of a pump which contains an amount of air but little less than the quantity sufficient to prevent its "getting water," the condition of the packing about the plunger plays a very important part. A very small leak in or around the packing will be sufficient to maintain the supply of air at a point which will prevent the working of the pump as before stated.

In more than one instance, with piston as well as with plunger pumps, the attempt to draw water to a considerable height completely failed, although an examination of the pumps proved it to be apparently in good order to the minutest detail. Repeated trials, even to filling the pump with water before starting, failed to make the pump "get hold" of the water, but in every case, as above, when the stuffing-box had been emptied and filled with new packing, the pump at once went to work without further trouble.

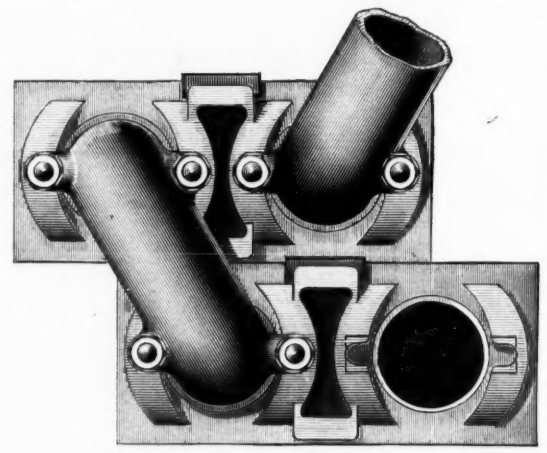
Many times in every-day practice, it has been found to give satisfaction to put in two pumps when water must be drawn from a well, and then forced into a boiler against 80 to 100 pounds pressure per steam-gauge.

In these cases, a common lifting pump was used to draw water from the well to a tank, on or above the level of the force pump. The steam pressure was then the only force against which the force pump worked, and as the feed-water would flow by gravity into this pump, its action was almost sure, even if the packing was slightly defective.

It is well known that many air pumps, especially when connected with vacuum apparatus, are fitted with a small reservoir of water which completely covers the stuffing-box, thus forming a "water seal," which completely prevents the ingress of air.

When it is inexpedient to apply a reservoir of this kind, or to use two pumps as before described, it will prove a great benefit to build a tank around the whole pump (provided it is a power plunger pump), and fill the tank with water. This device has the merits of being simple, cheap and easily applied, and it will prove a certain cure as far as leaky packing is concerned.

It also often happens that a pump is to be driven by a very long connecting-rod, say from 12 to 25 feet. In such cases, there is often great difficulty experienced in obtaining a light weight connecting-rod, which, at the same time, shall possess the requisite strength and stiffness. It is not unusual, in cases of this kind, to see the rod tremble and "buckle" at the commencement of every downward stroke. This action is not to be desired or tolerated.



Four light trusses, made from wrought-iron rods, is probably the most scientific method of stiffening the rod, but many times iron is discarded, and a wooden rod or "whip-stock" is made, having a cross-section in the middle of its length of sufficient area to prevent all tendency to "buckle."

When a light iron connecting-rod must be used, it answers very well to get out pieces of wood to fit the rod, and reach nearly from one end to the other. These "staves," as we will call them, are to be tapered from the center toward each end, and so shaped that when in place around the rod they will form nearly a true circle. They can be held in place by driving on a number of rings from each end of the rod, or by binding with wire. This method makes the lightest rod as well as the stiffest, and can be easily put together by any mechanic; whereas the wooden rod, with

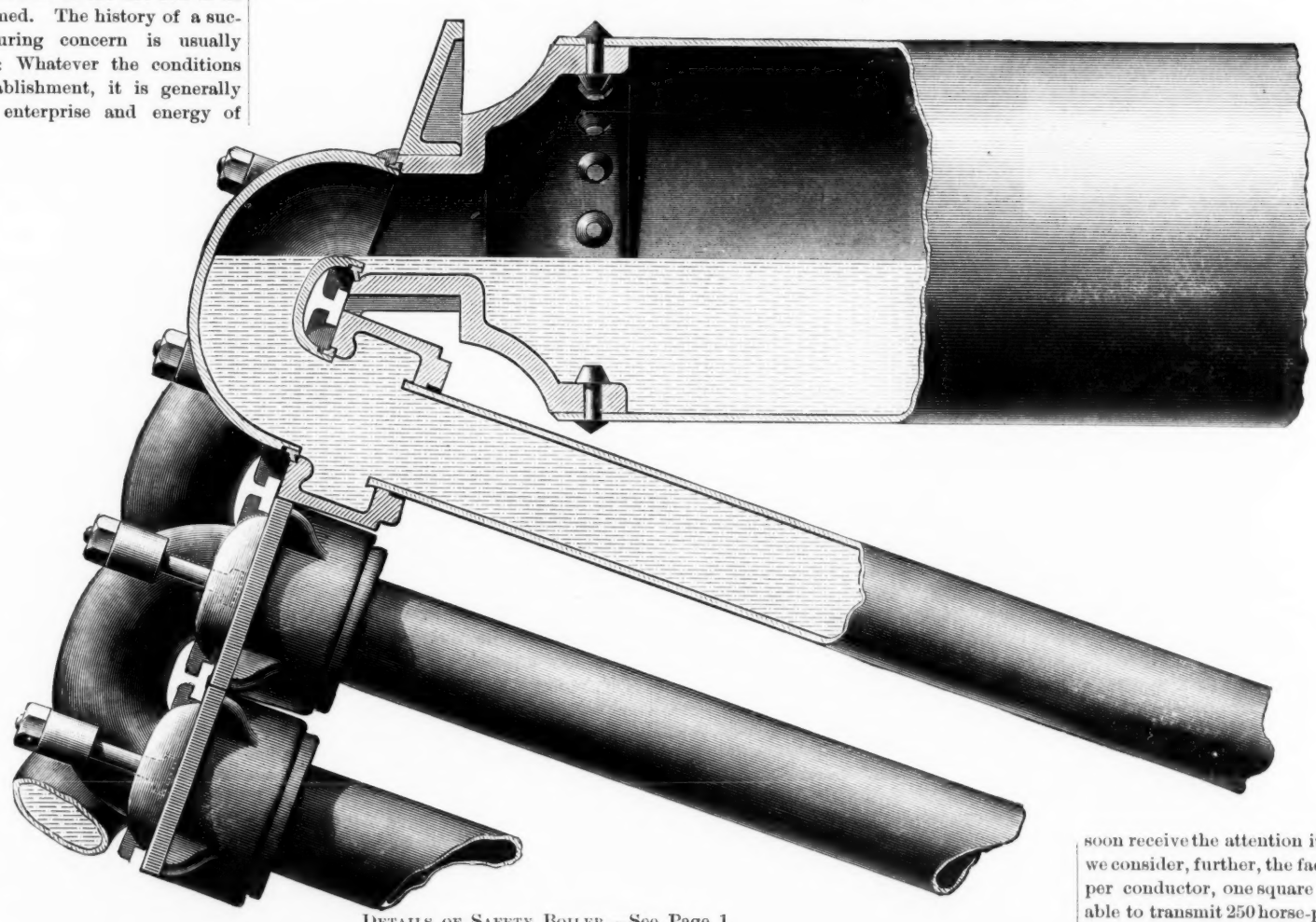
its end connections, is a nice piece of work, and much more time is required to make it than is required to stiffen up the original iron rod, which can be lengthened to any extent by cutting in two and "welding in" a piece of round iron.

Dry Rot in Manufacturing Concerns.

To what may be attributed the decline and final disappearance as active competitors for trade of manufacturing houses, once great and apparently as well situated to lead now as they ever were? This question has been asked us many times and in many ways. The answer may depend upon circumstances peculiar to each case considered, but certain broad generalizations are suggested by the inquiry which may be found to contain food for thought. In our judgment, the trouble with declining houses is generally that which an engineer would be likely to experience in an attempt to maintain his steam pressure without fresh fuel when that in the fire-box is in great part consumed. The history of a successful manufacturing concern is usually about as follows: Whatever the conditions attending its establishment, it is generally characterized by enterprise and energy of management. To realize the expectations which led to its organization, it must push vigorously for a leading place in the trade. Those who have put money in it have their capital at stake; those who enter without capital must make their services valuable, and acquire a competency for themselves during their years of maximum efficiency. Success is always stimulating, and the greater the measure of success secured during the first few years of its life the more enterprising such a house is likely to be. The managers are under constant tension. They must keep ahead at any cost, and they do it.

Fifteen or twenty years later a very different set of conditions obtain. The men who conduct the business are older and naturally less energetic. Probably they have become conservative. Having made money, they are no longer under the necessity of pushing for every advantage offered. Their attention is distracted by various interests which claim their time and thought. They have investments in various forms, and are likely to be directors of banks and financial companies. Perhaps they have become interested in politics, and have assumed more or less important and honorable public responsibilities. The social claims upon their time are more imperative than they used to be. Perhaps their health is not as robust as it once was, and the temptation to winter in Europe or Florida or Cuba is irresistible. Meanwhile their business runs along very well. It still feels the impetus of the years of its development. It pays good dividends and seems to be well established and prosperous. But it no longer leads. Younger and more enterprising houses have pushed to the front, and are skimming the cream of the trade. It is evident that this cannot go on for many years without a marked retrogression on the part of the house which is being left behind. Under these circumstances it is difficult for a man who has grown rich in the business to realize that he is no longer able to adapt himself to conditions which are always changing. He is apt to exaggerate the value of his experience, forgetting that half of it represents acquired habits, and that a good part of the other half is knowledge which is worth comparatively little at the present time. He is rarely able to recognize the evidences of dry rot in his business which others see so clearly, and he attributes the gradual retrogression of his concern from a first to a second or third place to various external causes which have no more to do with it than the precession of the equinoxes. The fact is, he and his associates have lost their grip. They are able to follow, but not to lead, and in a very few years they are likely to find that very little remains of their once prosperous and lucrative business.

The only remedy for this is the one of all others most difficult to apply, involving a confession which few business men are willing to make. It is to bring into the business new blood—young men of intelligence and judgment, who have the same incentive to energy and enterprise which inspired those who founded the business and made it great. Sometimes this can be done by advancing to positions of responsible management young men who have served the concern as clerks; but more often it will be found that clerks partake of the peculiarities of their principals and conform so closely to their habits and traditions that they could not be counted on to give the business a fresh impetus. They are apt to have too little independence of judgment, and to lack originality of ideas. The fact that they have remained clerks and subordinates rather militates against the supposition that they can be made more useful in other capacities involving large functions. The kind of men who are needed to infuse the spirit of progress into great enterprises are those who go naturally to the top, and such men are not often promoted. As a rule, they promote themselves. Nor is it often desirable that the new blood should be drawn from the veins of the trade. A man who has been brought up in the business is likely to be hampered by its traditions to such an extent that he lacks the courage of any new ideas that may come to him or from others. What is needed to stimulate a flagging enterprise is genius, and the less it is hampered by the fixed habits of the trade, the more useful it is likely to be.



DETAILS OF SAFETY BOILER.—See Page 1.

It is a fact well established by the records of discovery and invention that the productive industries of the world have always received their great impulses of progress from men who were not previously identified with them in any important or prominent way. In fact, it rarely happens that men thoroughly acquainted and intimately connected with an industry, contribute anything to promote its progress or originate any leading ideas. A clever man who comes fresh to a business of which he has no practical knowledge will accomplish more to advance it in one year than the veteran manufacturer would in ten years. He has no respect for established customs which cannot be shown to be the best. He is not deterred from experimenting by the knowledge of past failures. The most obstinately unprogressive man in the world is the man who knows a thing cannot be done "because he has tried it." He is misled by his experience, which is useful simply as showing, not that what he tried cannot be done, but that he failed because he did not try in the right way. Every man who succeeds, does something which others have unsuccessfully attempted. The chances of success are all in favor of the man who has not tried. To the clever and ingenious mechanic a scrap heap is full of interest and instruction, and he is likely to learn more that is new and useful and progressive from other men's failures than from their successes.

But the true secret of business success is not in the discovery of ways in which lost ground may be recovered. It is in holding every advantage gained, and steadily pressing forward in new directions. It is the part of wisdom to anticipate the decline which, if not foreseen and guarded against, is inevitable from the causes constantly and imperceptibly at work in successful concerns. Every few years should be marked by changes such as we have suggested. Those who have passed the meridian of their careers should retire and give place to new men with the incentive to and capacity for vigorous and successful enterprise. If some such rule as that compelling the retirement of army officers at a certain age could be enforced in our manufacturing industries, we should see fewer examples of that decay of great concerns which is shown by the decline of old centers of production and the rocket ascent of new ones. We could name a great many manufacturing concerns to which these remarks apply with peculiar force. The men who control them cannot hold on and do not know enough to let go. They do not see that younger and abler men, with fewer crotchets and prejudices, are needed in control, and that under such management their shrinking property would quickly increase in value. The progress of the trade has left them behind. Instead of leading, they follow; instead of creating new things, they are content to weakly imitate what other and abler men are doing. This answers the question which served us for a text, and the entire correctness of the answer will be conceded by every one except those for whom the question and answer have the greatest concern.—*Iron Age.*

Electric Lighting.

In a paper read at the Baltimore meeting of the National Electric Light Association, it was stated that the capital invested in illumination was second only to that employed in transportation.

The following, from another paper, is worth more consideration than it has received:

"How many small workshops there are in which a reliable power from a central station would be a boon. In how many situations would such a small motor replace costly manual labor or manual power. A little consideration of this subject cannot fail to impress any practical man with its importance, and to give rise to the hope that it will soon receive the attention it deserves. When we consider, further, the fact that a double copper conductor, one square inch in section, is able to transmit 250 horse-power over a moderately long distance without appreciable loss and without danger to life, and take this in connection with the present low price of copper, we must all admit the advisability of studying the problem of power distribution with the same energy as that of the electric light.

"Several attempts have already been made to utilize lighting dynamos during the daytime for the purpose of running electro-motors in the circuits."

On the subject of belting, it was said:

"Several years of experience seem to have demonstrated that a light double-leather endless belt without rivets is best, giving the greatest security against stoppage, and a steadier pull for the machine than results from other kinds of belting."

Regarding operating expenses, the statement was made that with a 200 arc plant, at an average distance from the fuel supply, using a mixture of slack and nut coal, the cost of the motive department should be about 32 per cent. of the total operating expenses.

Thomas D. West writes us: "In my article in your issue of March 6, I see I omitted the words green sand in the first sentence. The reading should be: "In pouring heavy *green sand* castings, etc. There is a large variety of heavy loam and dry sand castings which had often better be poured with open gates. This part of the subject I have very fully referred to in previous articles, which have appeared in the AMERICAN MACHINIST."

The Normal Theory of the Gear Tooth Curve.

BY GEORGE B. GRANT, BOSTON.

FIRST PAPER.

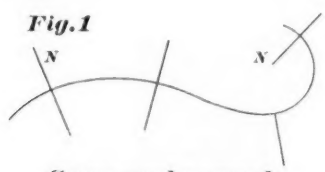
The usual method of presenting the gear tooth curve for the examination of the student, is to devote almost exclusive attention to the minute details of the cycloidal system, to hurry over the involute system, and to get the general tooth curve, without regard to any special form, into the smallest possible compass.

The result, to the student, is a more or less intimate knowledge of the cycloid, with a fixed idea that it is the only tooth curve worth his serious attention, a smattering, generally wrong at that, with regard to the involute and little or no acquaintance with the curve in its general and most interesting condition.

The subject should be begun at the beginning, and the beginner should learn what an "odontoid," or pure tooth curve is, what it does, and how it does it, before he is plied with epicycloids, logarithmic spirals, and the less important details of its special forms.

When properly treated, the gear tooth curve is not difficult to explain or understand, and is one of the most interesting and important applications of mathematics to practical mechanics.

Fig.1

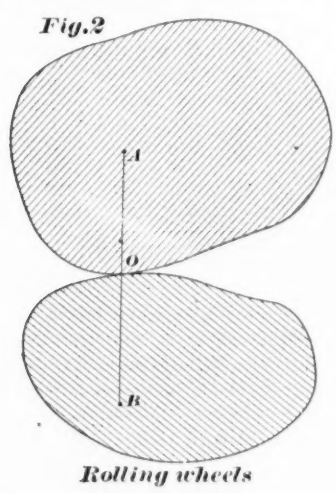


Curve and normals

THE NORMAL.

A normal to any curve is a straight line N, Fig. 1, which is at right angles with it at the point of intersection.

Fig.2

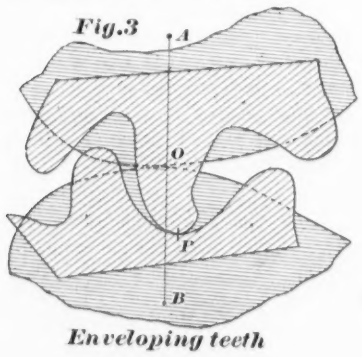


Rolling wheels

ROLLING WHEELS.

If two friction wheels, Fig. 2, roll on each other, their pitch lines touching at the pitch point O, they are, for the instant, revolving about centers A and B, which are in $A\ O\ B$, the common normal or line of centers of the two curves at their common point.

Fig.3



Enveloping teeth

ENVELOPING TEETH.

If teeth of any arbitrary shape, Fig. 3, are fastened to one rotating wheel A, they can be made to form teeth on a blank disk fastened to the other wheel B, which are the bounding curves, or "envelopes" of all their different positions.

These enveloping teeth can be formed by scribing lines about the originating teeth at short intervals of their motion, and then cutting out all the lines; or, if they are cutting tools, which reciprocate vertically, see Fig. 13, they will cut them out as the friction wheels roll together.

CONJUGATE TEETH.

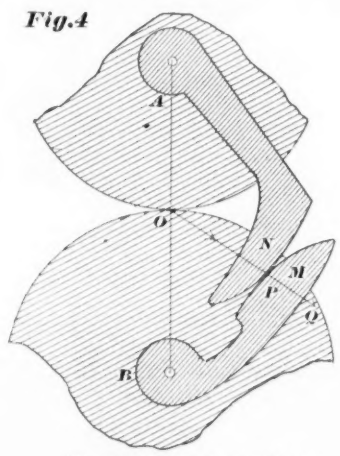
If the originating teeth be passed again through the enveloping teeth they have formed, the friction wheels rolling together as at first, they will not, of course, interfere with them or cut them again. With originating teeth of certain shapes they will entirely separate at times, and touch each other at other times, while teeth of certain other shapes will have the peculiar property that they will *continually* touch each other, and not separate at all from the first touch to the last.

The latter property is evidently of the greatest mechanical value, for teeth that have it can be used to forcibly transmit a uniform motion from one rotating wheel to another, without the feeble and uncertain assistance of the friction wheels.

Such teeth are said to be "conjugate" to each other, and their curves are called "odontoids," and, as some forms are conjugate and others are not, the property is evidently due to some peculiarity of their shape.

Conjugate enveloping teeth will form the originating teeth by the same process, reversed, on a new wheel blank like the original, but if not conjugate they will not always reproduce the originals.

Fig.4



Normal intersection

THE LAW OF NORMAL INTERSECTION.

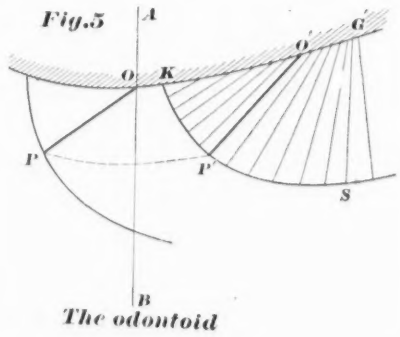
If the two odontoids, N and M, Fig. 4, are conjugate they are always in driving contact. They must always be tangent and not intersect at some one point P, and they must have a common normal, $O\ P$, at that point, which will intersect the line of centers, $A\ B$, at some point O.

The two wheels have a common velocity, $P\ Q$, of their common point of contact, P, along the common normal $P\ O$, and any common point O, on that normal, has the same common velocity in the same direction.

The two wheels can have a common velocity on the line of centers only at their common pitch point; therefore, the point O is that pitch point, and the first and most important law of the action of the odontoid is:

The normal to the point of contact of an odontoid with any other odontoid, always passes through the pitch point.

Fig.5



The odontoid

THE ODONTOID.

This law determines the general nature of the odontoid.

If $K P' S$, Fig. 5, is an odontoid the points $K\ O'\ G'$, etc., of the pitch line will pass the pitch point O consecutively, each one in its order, without a break, or a return in the order from the first point K to the last one used.

When any point, P,' of the odontoid becomes the point of contact P, the normal from it must pass through the pitch point O, and, as contact must be continuous, there must be a normal to the odontoid from every point of the pitch line.

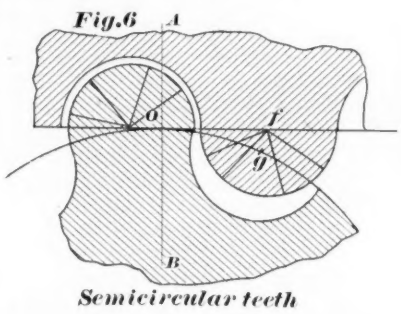
It is also a feature of any practicable odontoid that its point of contact continually shifts on it, a new point on the curve coming into contact as each point on the pitch line comes to the pitch point, without a break or a return in the consecutive order.

When there are many normals from nearly the same point on the curve, that point is in excessive use, and such a curve, although possible, is not useful. When the normals cross each other there will be a cusp formed on the odontoid, and it is impracticable.

As both ends of each normal must come into position in order, one after the other, they must be arranged as in Fig. 5, one after the other, without a crossing, and without a blank interval. This arrangement, for want of a more expressive term, may be called "consecutive," and our general definition is:

Any curve having consecutive normals to the pitch line is a practicable odontoid.

Fig.6



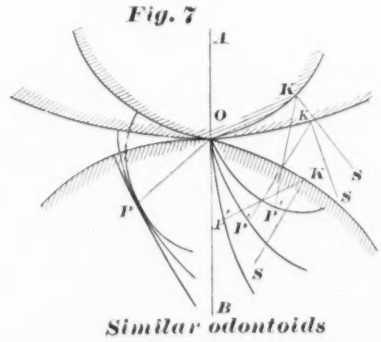
Semicircular teeth

For an example of a curve that is not an odontoid, although it is often treated as such, the semicircular teeth of the rack of Fig. 6 form enveloping teeth on the pinion which are circles of the same radius. All the normals to the circle intersect the pitch line at the center f, and the tooth will not touch the space until the centers f and g come together at O. Then all the normals satisfy the law, and the tooth fits and coincides with the space.

The absence of normal intersections on any part of the pitch line shows that the teeth will separate when that part is passing the pitch point, and the junction of two or more normal intersections will show that the teeth will coincide at that place.

It has been stated that any assumed and arbitrary rack tooth, within the limitation that it is "bounded by four similar and equal lines in alternate reversion, * * * will form an interchangeable set." The semicircular rack tooth is clearly within the given limitation, but it is not an odontoid, and will not form an interchangeable set. The conjugate tooth curve is subject to a law that is very elastic, but by no means indefinite, and which is seldom clearly given and often is given wrong by writers on this subject.

Fig. 7



Similar odontoids

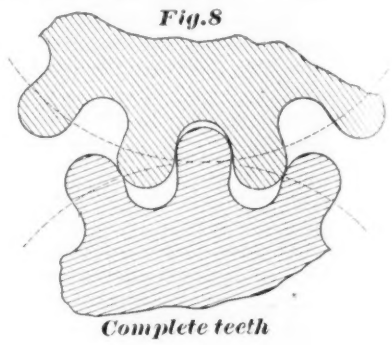
INTERCHANGEABLE ODONTOIDS.

If any number of odontoids, Fig. 7, are formed on the same side of a set of pitch lines that will all roll together at the pitch point O, and all the odontoids conform to the requirement that the normal arcs $O\ K$, normals $P'\ K$ and normal angles $P'\ K\ S$ shall all be the same, they may be called "similar" odontoids.

As any two of these pitch lines with their odontoids roll together, the points K will pass over the same arcs and come together to the pitch point O at the same time, and as the normals and normal angles are equal, the two points P' will come together at P. The two odontoids are therefore always in driving contact, without regard to the curvature of the pitch lines, and the general law of interchangeability is:

All similar odontoids will work in interchangeable contact with each other.

Fig.8



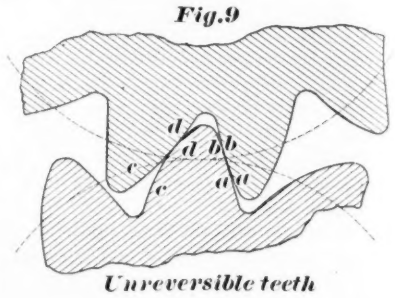
Complete teeth

FACES AND FLANKS.

The odontoid is on one side only of its pitch line and will be conjugate only to a similar odontoid on the same side of any companion pitch line, all being faces on one gear and flanks on the other.

Face gears and flank gears will work together but two face gears or two flank gears will not. To make a completely interchangeable set it is therefore necessary to provide each gear with both faces and flanks, all being similar odontoids, as in Fig. 8.

Fig.9

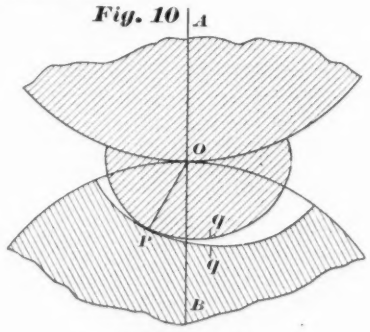


Unreversible teeth

REVERSIBLE GEARS.

If the two sides $a\ b$ and $c\ d$ of the tooth of Fig. 9 are not similar odontoids, the teeth may still belong to an interchangeable set, for the similar sides will always come together, no matter how the gears are interchanged. But if one gear of such a set is turned over, reversed face for face, the unlike odontoids $a\ b$ and $c\ d$ will come together, and it is necessary, to have the set reversible, that all four odontoids $a\ b\ c$ and d, bounding the tooth, shall be similar.

Fig. 10



Whole teeth

TRUNCATED TEETH.

When the point of contact P of the whole tooth, Fig. 10, is near the pitch line, its action on the mating tooth is nearly a direct push, but it becomes more and more oblique, with a wedging or crowding, as well as a pushing action, until, at the apex q there is no driving action at all, and the driven gear will stop unless both gears are so large that the next tooth is then in position, as in Fig. 8.

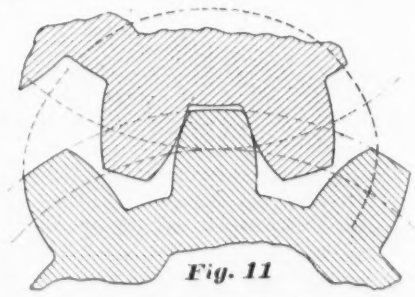


Fig. 11

Truncated teeth

To avoid this oblique action and at the same time allow the use of gears of few teeth, it is customary to truncate or cut off the apex of the curve, as shown by Fig. 11, by a line, called the addendum line, at an arbitrary distance from the pitch line.

The sides of the teeth are then brought as near together as is consistent with the required strength and we have the familiar tooth in universal use.

Making Columns Without a Pattern.

BY WILLIAM HULTGRAN.

The firm by which I am employed had an order that called for a certain number of round columns twelve (12″) inches in diameter, and having recently started in business they did not possess a pattern, and as the time allowed for their completion did not permit the construction of a full pattern I devised the following plan which, in every respect, worked successfully.

Base, moulding and cap of column were turned up in the lathe in halves, their inside diameters being made to correspond with outside diameter of shaft of column. Next we cut six strips 13½′ long by 4″ by 1¼″, and the same number of half-circular pieces 12″ diameter by 1¼″ thick, three of which were fastened on as many strips, one at each end and one in the middle, which makes one-half of skeleton pattern; the other half being made in the same manner and both doweled together in the usual way, we had a skeleton pattern that represented all the dimensions of our column, as in sketch, Fig. 1. Upon this skeleton we placed our turnings the proper distance apart, pins being used to keep them in their place, then to assist the moulder we made a sweep, Fig. 2, and a straight edge, Fig. 3, having a brace fastened on one side to keep it rigid in all directions while in use. Now, in order to enable the inexperienced to form a better idea how this and other castings of a similar nature may be made without the use of a full pattern, I will attempt to describe the manner of moulding.

The one-half of pattern without pins, is placed on a follow-board, then sand is rammed upon it as hard and solid as it possibly can be done, after which sweep Fig. 2 is used to give a half-round shape, at the same time removing all surplus sand. Fig. 2 shows pattern upon follow-board partially rammed and swept off. It is next sprinkled over with parting sand, the turnings are put on in their respective places, then the drag or mould is placed in position, rammed up and vented. Another follow-board is placed on top and the whole is clamped together and rolled over in the usual way, first follow-board is taken off, and after treating the other half of pattern identically the same as the first, it is placed upon its predecessor. Then the cope is put on, rammed up, and after flasks are parted, the pattern, together with sand around it, is lifted out with the exception of turnings, which are left in the mould to act as guides for straight-edge while sweeping away any irregularities that may have occurred during ramming. Fig. 4 and Fig. 5 show manner of using straight-edge.

As the greater part of pattern is made of sand, it is obvious that its surface does not offer the same resistance as one made of wood, consequently the straight-edge (which may also have a piece fastened on each end for sweeping up the core-prints, see Fig. 3), is used in finishing the mould; then turnings are removed, the mould is given its finishing touches, such as blacking and sleeking, the core is put in place, the flasks are closed and everything is ready for pouring.

Gas is furnished in London, England, at 60 cents per 1,000 feet. This cannot be on account of cheap coal.

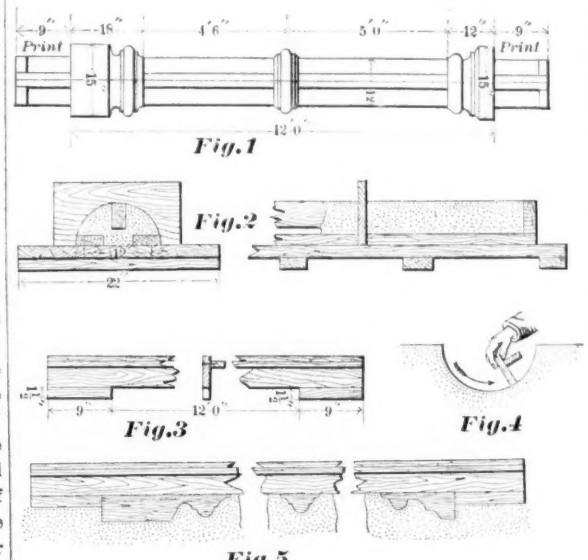
At the recent session of the American Street Railway Association, in St. Louis, the committee appointed to investigate the use of electric motors reported that they considered the use of electricity for street-car propulsion entirely feasible, and that the question was now simply one of comparative cost.

Ancient Hydraulic Power Transmission.

BY WILLIAM H. HARRISON.

The attached sketches are intended to represent a curious system of hydraulic-power transmission, which I saw about a dozen years ago in a tan-yard near Penzance in West Cornwall, England.

The entire thing was so ancient that no one about the place knew anything about its origin, but I was later informed that it was most likely a product of the genius of

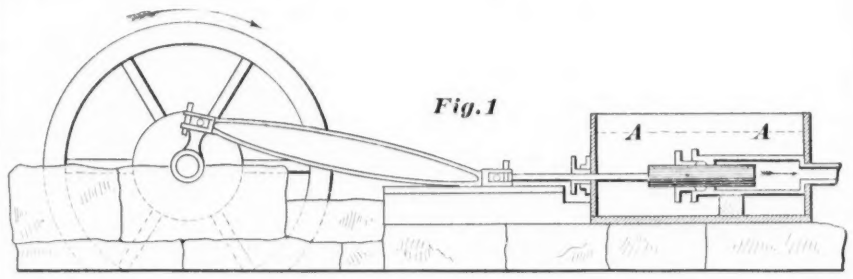


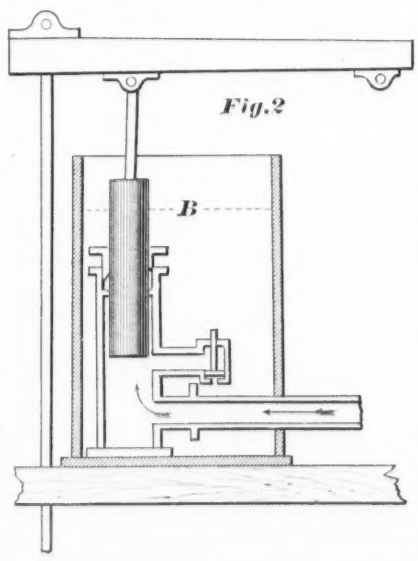
MAKING COLUMNS WITHOUT A PATTERN.

"Cap'n Dick," meaning Richard Trevithick, "that valiant Cornishman," of whom James Watt remarked that "he deserved to be hanged for inventing the high-pressure engine, and thereby causing death and destruction among his Majesty's subjects."

Fig. 1 represents an overshot water-wheel, with crank and pitman, connected to a single-acting plunger (Cornish "pole") pump. The water for the wheel comes from the drain ("adit") of an old and long-abandoned copper mine.

The machinery rests upon granite walls, and the gudgeons of the wheel run in granite or some other stone for bearing-boxes. This ct, in these days of bored boxes and babbitt-





ANCIENT HYDRAULIC POWER TRANSMISSION.

metal, seems difficult for the mind to compass; it may be possible that the material was soapstone.

The Cornish people use granite very freely for most everything. I have seen there an old cider-mill, the grinding apparatus of which consisted of two edge-runners, moving in a large circular trough, similar to our pans and rolls or mud-mills, and all of granite. The bed of the press was of granite, and the troughs for catching the juice were of the same everlasting material.

The pump is located in a cistern of plank, the use of which will appear later on. There is a rough stuffing box around the plunger, but no valves to the pump. A pipe of lead extends from the back end of the pump to Fig. 2, which is in the tan-yard some forty rods away.

Fig. 2 is a similar pump to that shown in Fig. 1, but stands upright, and the plunger connects to a half beam, from the end of which depends the pump-rod, the business of the machine being to pump the tan-yard liquors.

It is obvious that when the pump-barrels and the pipe have the proper amount of water within them, that Fig. 2 must make stroke for stroke with Fig. 1, but with the rude stuffing boxes there must be leakage and a good deal of it, both of air from without, and water from within, so to prevent the air leak the cisterns are kept filled with water up to the lines *A* or *B*, and to make up for the loss of water, the small check-valve in Fig. 2 opens whenever the pressure inside is less than the atmospheric pressure, and admits water.

The climate of West Cornwall is particularly favorable to such a sloppy apparatus as this, there being lots of rain and but little cold weather in winter, and the grass is green all the year round.

LETTERS FROM PRACTICAL MEN.

Burning Saw-dust and Bark.

Editor American Machinist:

Having received great benefit from reading the letters from practical men, I feel tempted to help, in my small way, a correspondent who is troubled with his smoke-stack burning out, and who asks for a remedy from some one who has had trouble in the same way. I had a little experience in sooty flues and smoke-box from wet sawdust and bark, and used to have a burn-out often at noon, when the fire was low. I have eight boilers, 48″ diameter by 16 feet long, and at first built them in with grates, 8 feet long, thinking that the larger the grate area, the better the combustion. But I could not keep steam to run half what I drive now, and had to find a remedy. The draft was too sluggish. I could not change my smoke-stack, so I thought I would try less grate area. I simply laid fire-brick across the back end of the grate-bars, and raised the bridge wall within 8″ of boilers. I made double the steam I could before, and the tubes and smoke-boxes and breeching were free from soot, and have never burnt out since. If your correspondent will reduce his grate-bar area from 30 to 20 square feet, he will find the combustion of his wet fuel so improved that there will be little or no smoke to form soot. I also suggest, if there is no pit or combustion chamber behind bridge wall, that he make one, as I consider it a great help in preventing soot forming. Since trying the experiment for myself, I have induced others to try it, where the draft was slow, and have found it to work like a charm. My theory is that reducing the grate area saves increasing the smoke-stack area, and sharpens the draft, which is what tan-bark or any close-laying fuel requires.

THOS. PRICE.

Revising Text-Books—Diagonal and S Wrenches—About Crown-Face Pulleys.

Editor American Machinist:

It does not seem strange that many inaccurate statements of a scientific character appear in the daily newspapers, but when they can so frequently be found in works of science and philosophy, it seems high time that every word and every illustration therein contained should be subjected to a strict revision by competent judges before another edition is published.

A work on natural philosophy, an edition of 1884, in speaking of the high-pressure engine says: "Many engines, therefore, have no condenser, they exhaust directly into the air. The air condenses the steam and itself fills up the vacuum, so that the piston in returning has to drive the air out of the cylinder ahead of it." "It has been found that the steam produced from one cubic foot of water will just about raise 1,000 tons one foot per hour, so that an engine which can change five cubic feet of water into steam each hour is a five horse-power engine."

Experience teaches that most steam-engines change a part of the steam into water, but to suppose that an engine can change water into steam, and by its capacity for doing this the horse-power of the engine be estimated is, I am sure, a new idea to many of us, though not a very bright one.

The description of a safety valve is as follows: "An opening is made in the top of the boiler, which is closed by a close fitting plug of iron. This plug is held down by a lever arm, at the end of which is a certain weight. When the pressure of the steam becomes so great that there is danger of its bursting the boiler, it lifts this plug and escapes." The only illustration of a high-pressure engine in this work resembles very much the Stevens locomotive of 1833.

From a newly advertised catalogue of practical and scientific books, I ordered a work on the steam-engine indicator, hoping to learn of late achievements. When the book arrived my disappointment was great when I discovered that the work was written thirty-one years previous. A revised edition of Richards' "Steam Engine Indicator," 1880, says: "Sir Wm. Fairbairn found by a series of experiments that in constructing internal flues for boilers, when the pressure was from the outward to the center (centripetal), that as the length was increased the thickness of plate must be increased in direct proportion. That is, if ¼-inch plate was right for a 10-foot length, if the flue was 20 feet in length, the plate must be ½ inch to stand the same pressure." Do the most intelligent boiler-makers build their boiler flues of different lengths in this proportion?

The popular American dictionary of the English language, illustrated, published in 1884, shows a left-hand auger. Locomotive is illustrated by a fair representation of "Old Ironsides" of 1832; a screw by two hop vines twining around a telegraph pole—with the sun. "Spiral" appears to have been printed with one end of a sheet of corrugated iron roofing. The cut "Windmill" was possibly taken from "Don Quixote," with the brave knight and his steed left out.

Here is an article which has been going the rounds for years, and still appeared very recently. "A machinist has discovered that by keeping his turning tools constantly wetted with petroleum, he was able to cut metals and alloys with them, although when the tools were used without the oil their edges were turned and dulled. The hardest steel can be turned easily if the tools be thus wet with a mixture of two parts of petroleum with one part of turpentine." Wonder if Fink ever used petroleum and turpentine?

When we peruse one of these works in the earnest endeavor to obtain knowledge and find some assertion which conflicts with learning already acquired, we feel weak, and are

liable to doubt the accuracy of the whole work.

Don't make an S wrench for general use. A diagonal wrench can be worked anywhere that an S wrench can, and in some places where the latter cannot. Reasoning backward, it may have been that a blacksmith long, long ago, made a straight wrench to fit square nuts. Finding that he could not very well turn a nut in a corner less than 90 degrees, he made an O G curve in his wrench which proved more serviceable, as by turning the wrench over every time, before taking another hold on the nut, he found that he need not swing the wrench more than 45 or 50 degrees to turn a square nut. Could he but have turned the square openings 22½ degrees from a straight line between them or made another wrench, a diagonal wrench, it would have been neater, stronger and lighter. It appears, however, that millions have held to the ancient blacksmith's S wrench without knowing why or how it happened. Some have stopped to think, however, and to-day diagonal wrenches are used as well as S wrenches. In a hexagonal diagonal wrench, let the angle formed by a line across corners of nut and center line of wrench be 15 degrees; when so made, 12 equal shifts can be taken on one revolution of a hexagon nut by turning the wrench over every time.

In reply to C. W. Crawford, in the American Machinist, February 13, I would say: When running on a crown-faced pulley, the center of the belt is drawn ahead of its natural position; and when running off at the other side, it gradually settles back to natural position to be again stretched ahead when approaching the pulley. It may thus be understood that although the average speeds of the center and the edges of the belt are the same while between pulleys, the center travels faster than the edges while turning on the pulley. Therefore, it is quite possible, and often probable, that belts do run on crown-faced pulleys without slipping. I believe that the amount of power consumed with crown-faced pulleys over straight-faced pulleys is generally overestimated, and can be determined only by careful experiment.

J. E. McConnell.

Foundry Floor in Second Story.

Editor American Machinist:

A correspondent in the American Machinist, Feb. 27, contemplates building an iron foundry which must be in the second story, and mentions that he thought of laying a 2″ plank floor, and on top of that a thick coat of coal tar, on top of the coal tar a thickness of 1″ boards and on top of that another thick coat of coal tar, and then a covering of clay 2″ deep.

I have never had any experience in second story foundries, but from the experience I have had in foundries, I would not want to build a floor of that kind. There are moulders who would keep a floor of that kind in good order for a long time, then again there are others who would soon have the floor all hills and hollows, cutting through the 2″ of clay to the coal tar or planks making it rather dangerous for run outs, and the spilling of iron, which is liable to occur in all foundries. From the class of work that I conclude a firm would manufacture in a foundry, in the second story, I would prefer for safety from fire and to have a smooth even floor, to build one as follows:

First, have the joists subtantially braced underneath; on top of the joist lay the 2″ plank floor and cover this with a thick coat of coal tar as mentioned above. This coal tar I would use simply to keep the moisture from the wood and preserve it. On top of the coal tar I would spread a thin coat of rather stiff cement mixture, and into this I would bed good hard brick for the top of my floor. The brick would absorb most all the moisture from the mortar, and the sand used in moulding would protect the bricks and keep them from getting broken, and would also keep the joints between the bricks filled up so that no iron could get to the tar or planks underneath. If your correspondent does not like the idea of using a brick floor, he could bed thin cast-iron plates into the cement. Either one of these floors I believe would be equally as cheap, if not cheaper in the end, than the one covered with clay.

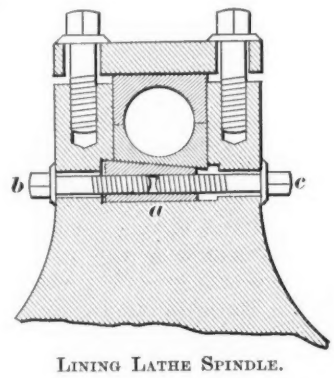
I would not have the cement or concrete come in contact with the plank. I saw a plank floor in a machine shop taken up this winter, where the joists were 3″×8″ set up edgewise and filled in between with concrete on a level with the top of the joist; this floor had only been down a little over five years, yet the joists were entirely rotted out.

Robert E. Masters.

Lining Lathe Spindles.

Editor American Machinist:

I think the fault that Mr. Page mentions in the American Machinist of February 20, in regard to lathe-spindles wearing out of line



Lining Lathe Spindle.

with the bed, is a common one; that, perhaps every machinist who thinks at all, has given some thought in search of a remedy that could be applied in a few minutes, at any time, without having to lift the spindle out of its bearings.

I inclose a sketch of an idea I have for the purpose, as a suggestion to lathe builders. I think the sketch conveys the idea clear enough to need but little description. A wedge-shaped piece *a*, is fitted into the head-stock under the bearings, as shown in the sketch. A hole is drilled and tapped through the head-stock to receive the adjusting screws *b* and *c*, by which (after loosening the cap-screws) the wedge may be adjusted in either direction, and the spindle raised or lowered at will. The screws *b* and *c* drawing against each other, serve as a "jamb," by which the wedge may be fixed in any part of its movement. This idea, so far as I know, is not patented. Perhaps some one may have an idea that is superior to the one described; if so, I hope he will send it to the American Machinist, for it is only by the exchange of ideas and opinions that we can arrive at the best.

B. E. Parks.

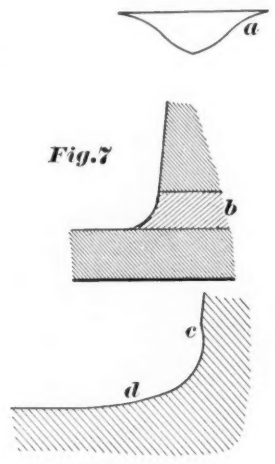
Ferrysburg, Mich.

Making Large Box Patterns.

Editor American Machinist:

What I have to say relates only to the flanges or collars forming the babbitt chamber, see Fig. 2. Of course, in the cap to the box, no trouble will be found in getting the pattern out of the sand, if the collars are permanently fastened to the cap; but they must, in the bed of the box, be doweled or dovetailed on. I have never seen but two methods used in the making of these collars. The first was to make them a full half-circle, and giving a great deal of draft, as shown in Fig. 4, or, perhaps, even more, thus reducing the face of the collar very materially. The second was about the same, only not so much draft was required, and the collar was cut radially into three or four segments, as shown in Fig. 3. In both cases these were doweled (see Fig. 2) or dovetailed to the body of the pattern, and by the prodigal use of the rapping bar, they will come out of the sand.

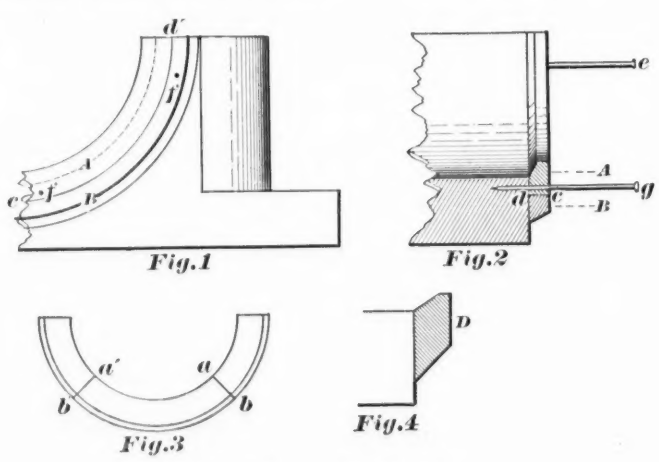
Now, we will turn out our collars in the ordinary manner, cut them in halves, and use one-half for the cap, the other half for the base. Take a fine, thin saw, cut this last half of the collar into two pieces, making two full half circles, as on *c d′*, Fig. 1, and *c d*, Fig. 2, shown in section. Then varnish them, and



Fillets.

fasten the base by three long dowels—two in the outside segment, near each end, and one in the middle of the inside segment; or, dovetail them on. When the pattern has been rammed up, the moulder can dig down and pull out the pins *e g*, Fig. 2, and then draw the base. To get the collar out, first draw the segment marked *B*. This will allow *A* to be drawn up and out. This method is probably old to many; but it is not in common use here in the west, at least.

Aaron Louis.



Making Large Box Patterns.

Preserving the Smoke-Stack.

Editor American Machinist:

I noticed in last week's paper your correspondent's trouble with his smoke-stack. Having had much the same experience, it may be of interest if I give it.

In stave (barrel) manufactories this is a constant trouble, the stave-bolts, in steaming, throw off both heat and moisture, and with it some powerful agent that will eat away nails or spikes, and allow the wood-work to fall apart though yet sound. I used wrought nails, but these would rust away quicker than the common cut nails. Have seen ½″ bolts eaten completely away in less than three months, and this only by steam. Oak-stave bolts were more destructive than elm, proving conclusively that it is the tannic principle that attacks.

The causes why your correspondent's stack gives out are as follows:

Tan bark is thrown on a hot fire, and immediately hot moisture goes back with the draft charged with this destructive agent, (be it what it may, tannic acid or creosote), which of course attacks the iron stack. To in part remedy the trouble, my idea would be to reduce the moisture by drying the bark, and when putting up a new stack, put up a smaller one, get it closer to the boiler and run it up higher, (using the commonest grade of iron), for the purpose of quickening the draft, and thus allowing less time for the products of combustion to condense on the cold stack.

Jas. Naylor, Jr.

The University of Tokio; Tokio, Japan, through Mr. H. Kato, state that they are desirous of receiving and filing for reference, by students, professors and others, all forms of trade catalogues and other publications bearing upon engineering works. The sending of matter of such kind for such purpose, is so obviously cast'ng bread upon the waters, which is very likely to return to the senders after many days, if not sooner, that probably nothing more is needed than to call attention to the request to insure compliance therewith.—*Mechanical World.*

Clean out the water-tub in your blacksmith shop. The amount of filth which will collect in a year, in that useful receptacle, is something astonishing to the man who never gave the matter a thought. Clean the tub occasionally.

Some persons seem to forget that there are two surfaces to a sheet of tin, says a correspondent of the *Tinner and House Furnisher*. They see the upper surface and take care of that, but forget that the under surface equally needs to be kept free from moisture. Water on the under side of a tin roof will produce rust about as quickly as water on the top surface. To prevent sweating and condensation of moisture on the under side of a tin roof is a point which must be guarded against by thorough ventilation, if we would make the roof last.

Engineering Laboratory of the Michigan University.

Of the new engineering laboratory now being constructed at the Michigan University, the *Michigan Argonaut* has the following:

The basement of the new building will be the mechanical laboratory; it will contain an office, a computing room, in the north-east corner, the balance of the floor being devoted to machinery for experimental purposes. A steam-engine, with condensing apparatus for making complete engine tests, will be one of the features. Apparatus for carrying out hydraulic experiments, including water-wheels, pumps and injectors, trains of mechanism, including spur and bevel-gearing, friction gearing and belting and transmitting and absorbing dynamometers, will be other features. A part of the basement will be devoted to a testing machine of about fifty tons capacity. Students will in this laboratory have an opportunity for gaining a practical knowledge of the work, which heretofore they have studied mainly from the theoretical standpoint.

The first floor of the new building will be the iron room, or machine-shop. A portion will be set apart for a drawing-room and superintendent's office; the balance will contain six or eight engine-lathes, speed-lathes, planer, drill-presses, shaper, milling machine, emery grinders, etc. A fine vise-bench will extend around the sides.

The second floor will constitute the wood-room and pattern-shop, containing the tools in the present wood-room, and a few additional tools, including the fine iron saw-bench now being finished in the iron-room, and a band-saw, which will soon be commenced.

The attic will be used for the storage of patterns and lumber. An elevator will eventually connect all floors.

The old brick building, which has served such an admirable purpose to the present time, will be remodeled into an engine-room and wash-room, the main shaft passing through the walls and into the new building. The old wooden building will probably be converted into a forge-shop and foundry, giving the additional room which is so much needed.

Pattern-making.

By F. W. Barrows.

FIFTH PAPER.—FILLETS.

The mere thought of fillets is enough to make most pattern-makers feel tired. Fillets worked out of the solid wood of the pattern, oftentimes resemble almost anything but what they are intended for, being more or less

cut and hacked, and varying in size and shape, according to their location. They are generally pretty good, when they follow the outside of a curve; but when they are on the inside of a curve of short radius, and the grain of the wood runs the wrong way, it does seem as though the pattern-maker's trade was a little the worst business in the world.

Sometimes wood fillets are made and put into the corners; but they are not adapted to crooked corners, and it is hard to make the thin edges lay down tight. Even after they are put in in good shape, after being moulded a few times, the edges begin to curl up, and if any glue has been used, it works out, and makes the moulder unhappy. A good way, when glue is used, is to wet the outside. Then the edges will stay down until the glue sets.

There have been various ways devised to overcome these difficulties. A favorite method is to make the fillet of leather. To accomplish this, a plane has been devised, which, when it is in good order and in skillful hands, will shave off a strip of leather, with a section like *a*, Fig. 7. This, after being wet and well rubbed into the corners with varnish, to make it stick, will look very well, if you don't expect too much. There will be a hollow wherever a nail is driven, and a corresponding fulness at the edge. If the angle is very crooked, the leather fillet will look like the crimped edge of an old-fashioned pumpkin pie; but any little irregularities like these can be overlooked, for the leather fillet is really a very good fillet, having one quality—durability, which other fillets have not.

Then there are wax fillets, and fillets of putty, which look better or worse, according to the skill and tools used. I have found a round rod of the same radius as the fillet, and having the end turned off round, to work first-rate. For wax, warm the rod so that it will not stick; for putty, wet it.

The best fillet made is when it is worked out solid. For crooked places, the fillet is worked on a piece by itself, like *b* in the cut. But owing to the time necessary to do this in good shape, and the consequent cost, it is often dispensed with, and some cheaper method used. Putty and wax are both cheaper. Wax is probably the most used, as it is easier to work, and gives better results for the time expended. For large fillets, putty is, perhaps, better after it gets hard, which takes a long time. The angles should have a light coat of lead and oil, before using the putty, or it will not stick.

When you turn a fillet between a flange and body, don't cut in too deep, like *c*. This makes the moulder trouble. Also, do not go to the other extreme and begin the fillet half way across the pattern, like *d*.

It is sometimes necessary to make a pattern in a hurry, and then, perhaps, you will be persuaded to let the moulder cut the fillets out of the sand. I don't know whether this gives the moulder any satisfaction; but as a rule, the appearance of the casting isn't such as to give much pleasure. It is hard for the moulder to make a sharp corner of sand from the nature of the material; neither is it always practicable or advisable to put fillets in all corners, so we shall probably go on about the same as usual; some using wood or leather and putting in the hard places with wax or putty, and giving the moulder, and the man who pays, more or less satisfaction—more for the moulder, when the corners don't break away, and less for the payee, when the bill is large.

The *Modern Miller* says: "In making a test of the comparative value of wood and coal for fuel in Kansas, it was found that where the coal was very poor, having in it more sulphur and slate than the best bituminous coal, one ton of coal was equal to one and three-fourths cords of the best hard wood, and two cords of dry soft or green hard wood. The quality of coal in Kansas varies as much as the quality of wood. In Missouri, Ohio and Indiana, where better qualities of coal can be obtained, one ton of coal will equal two cords of the best wood."

Suckow's Extension Jack.

This jack is provided with a ball and socket bearing at base and top of screw. The ball bearing at the base permits the body to move

EXTENSION JACK.

in any direction about 30 degrees from the perpendicular. The bottom ball is held by two screws, one fitting in a groove in the ball, the other clamping the ball so as to make the jack stiff and solid in any desired position; this can be loosened so as to make a complete carrying jack.

Another advantage of the ball bearings is that the screw will always work free, instead of being cramped, as is usually the case when packing strips must be used.

The screw is of steel with lathe-cut half-V threads, the nut being bronze. The peculiar construction of this jack especially fits it for wrecking purposes, while its convenience for general use will be apparent.

Manufactured by Pedrick & Ayer, at the L. B. Flanders Machine Works, Philadelphia.

Electrical "Grounds."

At present it is customary to "ground" telephone and other electric wires by connecting the same to water and gas pipes. Eventually the time will come when such practice must be forbidden, and its prevention enforced by statute.

In the past, and at present, there has been but little cause for apprehension in regard to danger from this source, but, as the number of wires increase, as electric light wires are brought in great numbers in close proximity to the existing wires and their ground connections, the danger is greatly increased, as a wide field for damage is opened when a broken wire, conveying a high-tension electrical current, comes in contact with the present system of existing wires, connected as they are with a common ground.

Other ground connections must be provided, and such connections must be distinct from each other, and not used in common as at present.

Hurley's Automatic Steam Flue Cleaner.

In this device the nozzle consists of a cylindrical shell, made with a conical face. This shell is divided into two parts, the opening between them being controlled by means of a conically-seated valve. The outlet consists of an annular opening around a central concave diaphragm. The back end of the shell is closed by means of a screw plug, through which is an opening provided with a stuffing-box, for the stem of the valve previously referred to.

The steam pipe enters the side of the shell, as shown in the engraving. A flexible hose is used for completing the connection with the steam supply. The operation of the lever for opening and closing the valve will be readily understood from an inspection of the engraving.

The operation may be described as follows: The proper connection is made with the steam supply and the nozzle inserted in the tube. Then by pressing or releasing the grip lever, the steam is admitted or shut off.

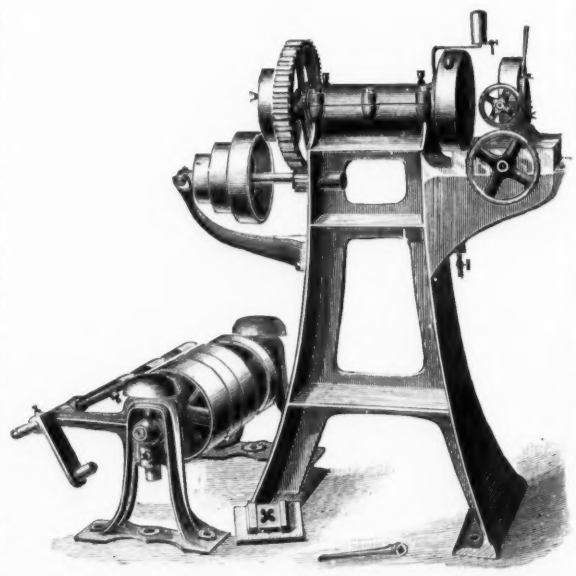
The manufacturers of this flue-cleaner are the F. F. Adams Co., Erie, Pa.

Pipe Cutting and Threading Machine.

We herewith illustrate a pipe-cutting and threading machine, which is being placed on

AUTOMATIC FLUE CLEANER.

the market by Forbes & Curtis, of Bridgeport, Conn. This tool is designed to be quickly handled on all sizes of pipe from



PIPE-CUTTING AND THREADING MACHINE.

$\frac{1}{8}$ to 2″, right and left. On pipe from 1″ to 2″ the die-carrying head is furnished with opening adjustable dies, which can be opened when the pipe is cut, thus saving reversing the machine and running back over the thread. On pipe smaller than 1″, solid dies are used, although, if desired, adjustable dies for all sizes can be furnished. The four sizes of pipe, from 1″ to 2″, are threaded without changing the dies, and all that is required to adapt them to the several sizes, is to remove a pin from one hole to another.

The cutting-off attachment is self-adjusting. The chuck is of an entirely new design, and a centering chuck is also placed on outer end of spindle. The oil-drip is directly under the sliding head, and can be removed when full of chips. The machine is furnished complete, with countershaft, wrenches, etc. Should parties desire this machine to be operated by hand, it can be so arranged.

Manufactories for St. Paul.

The people of that flourishing and progressive city, St. Paul, Minn., are very desirous of securing a number of manufacturing establishments to locate within their borders or a short distance outside. They are willing to extend proper encouragement to suitable manufactories that are ready to locate. This, however, does not take the form of exemption from taxes or a bonus raised by public taxation. Such methods are decidedly objectionable. Their plan is one that works no injustice to any of the eight hundred manufactories already running in that city. The St. Paul Chamber of Commerce in which all the business interests of the city are represented, has a committee on manufactures which will diligently work to increase those productive enterprises that employ labor and consume supplies. There are two "Syndicates" organized principally among members of the Chamber of Commerce, one of which owns 800 acres and the other something over 200 acres, upon which inducements will be made to manufacturing establishments to locate. The former has donated 25 acres to the Minnesota and Northwestern Railroad, upon which a round-house and repair shops will be built as soon as plans are perfected. The latter syndicate has offered a bonus of $10,000 to the Bohn Manufacturing Company, of Winona, Minn., to move their sash, door and blind factory to a site already owned by that company in St. Paul. The company now employ 250 men at Winona, besides a small force at their shop in the latter city. Negotiations are now pending for the locating of several manufactories that desire a bonus on land owned by these syndicates, the members of which expect to be more than reimbursed by the increased value of their land reserved for sale in small lots.

A loan syndicate is also to be formed among the Chamber of Commerce men to assist new factories by loaning them money at a low rate of interest (say three or four per cent.), to enable them to become established.

Taxes in St. Paul are now only about half those paid on property of equal value in New York or Brooklyn. The era of municipal extravagance has not yet arrived in that city. Transportation is amply provided by railroads in every direction and two water lines—one by the Mississippi river, and the other by the great lakes via Duluth. Railroad competition makes freights low both winter and summer. Soft coal can be supplied to manufacturers at $3.00 to $3.50 a ton making steam-power almost as cheap as water-power. The secretary of the Chamber of Commerce, (to whom all inquiries about inducements to new manufactories may be addressed), informs us that he has made considerable investigation as to relative cost and convenience of steam and water-power in that part of Minnesota. He finds that many owners of mills and factories are discarding water-power for steam. Several of the great flour mills of Minneapolis (where one of the finest water-powers is fully utilized), are putting in steam-engines owing to the uncertainty of the supply of water. At Winona, two roller flour mills, each grinding 2,000 barrels a day, formerly run by water, are now run by steam-power alone. They declare steam to be the more economical for steady running, and by far the most reliable.

Mechanics are welcomed to St. Paul, and are not made to feel they are inferior to any other portion of society. Neither the press nor the citizens of that enterprising place put any slight upon the workmen who make homes there and add to the common prosperity. The prospects are that St. Paul will become quite a manufacturing city.

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NEW YORK, MARCH 13, 1886.

CONTENTS.

	PAGE
Safety Boiler for High Pressures	1
Main Reciprocating Parts of High-speed Engines. By W. H. Hoffman	1
Plunger Pumps. By James F. Hobart	2
Dry Rot in Manufacturing Concerns	3
Electric Lighting	3
The Normal Theory of the Gear Tooth Curve. By Geo. B. Grant, Boston	4
Making Columns Without a Pattern. By William Hultgran	5
Ancient Hydraulic Power Transmission. By William H. Harrison	5
Letters from Practical Men—Burning Saw-dust and Bark. By Thos. Price—Revising Text-Books, Diagonal and S Wrenches, About Crown-Face Pulleys. By J. E. McConnell—Foundry Floor in Second Story. By Robert E. Masters. Lining Lathe Spindles. By B. E. Parks—Making Large Box-patterns. By Aaron Louis—Preserving the Smoke-Stack. By Jas. Naylor, Jr.	5, 6
Engineering Laboratory of the Michigan University	6
Pattern-making. By F. W. Barrows	6
Suckow's Extension Jack	7
Electrical "Grounds"	7
Hurley's Automatic Steam Flue-cleaner	7
Pipe-cutting and Threading Machine	7
Manufactories for St. Paul	7
Running by Momentum Only	8
The Pennsylvania Railroad Relief Fund Scheme	8
Cutting the Tariff by Indirection	8
Reaction Against Iron-clads	8
Fink Seeking New Pastures	8
Literary Notes	8
Questions and Answers	9
Manufactures	9
Machinists' Supplies and Iron	9

Running by Momentum Only.

One of the noticeable things about a good many establishments is the disposition to do business on the plan of what school-boys call "steady-by-jerks." More elegantly expressed, it may, perhaps, be called the plan of running by momentum only.

A railroad train or an ocean steamer, which was run on the basis of every once in a while getting up a tremendous spurt of force and speed, and then shutting off further effort until all the impetus so acquired had been used up, would not afford a very desirable means of traveling or shipment. But this is about what a good many concerns in business regularly make a business of doing.

Instead of inaugurating a system looking to the steady improvement of their plant, and the steady growth of their business, such establishments neglect the work of improvement until compelled to "do something" hastily, which should have been done carefully and advisedly.

It is establishments of this kind which are "so busy" that they do not find time to keep posted on new machinery and new methods, as they come out, until brought face to face with them in the course of competition, to the loss meantime of many points of vantage. It is establishments of this kind, which are content to be heard of only at intervals, the length of these intervals being only measured by the condition of their business meanwhile.

It is establishments of this kind that do nothing to improve their products, so long as they can keep even with competition. It is only when the reputation of their product begins to suffer by comparison with that of their competitors, that the question of getting ahead of competition, instead of merely keeping even, is raised. It is establishments of this kind which only lengthen the list of articles manufactured by them, not as part of a progressive plan, but as affording, for a time, a basis for the more congenial method of running by momentum only.

Sometimes it happens that the very success which such an establishment may meet, in the way of running a long time in a certain groove without thought of improvement, operates to its greatest disadvantage, in the fulness of time and the growth of competition thereof.

The Pennsylvania Railroad Relief Fund Scheme.

In our issue of Feb. 20, we briefly referred to what appeared to be objectionable features of the relief department, as proposed by the Pennsylvania Railroad Company. Inquiry at the time showed that the employes were decidedly opposed to the plan, and that nothing but coercion could bring them to accept it. Evidence that it does not find favor may be gathered from the following circular, issued by the company:

Attention having been called to the fact that a considerable number of employes object to some of the features of the Relief Fund recently established, and as that department was organized solely for the benefit of the employes and their families, and is therefore one in which they have a direct personal interest, outside of the operating organization, and as its success depends upon the hearty co-operation of all parties interested, it has been decided to call a representative meeting of the employes to afford them a full opportunity to express their views upon all questions connected with the relief department. Directions have accordingly been given to the division officers to request their employes to select two representatives from each branch of the service, on each division, to meet me at Broad Street Station on Tuesday, March 2, 1886, at 10 A. M., to consult with regard to the general features of that department. It is the desire of the company to so frame the regulations of the relief department as to make them most satisfactory and beneficial to the employes, and it is believed a full discussion will accomplish the result. It is suggested that, meanwhile, further applications for membership be withheld.

If the company had been so completely imbued with a desire to benefit their employes as the above is intended to show, common sense would have dictated some such course as indicated, in the beginning, in place of the stand-and-deliver policy adopted. Even if there had been no other objection to the plan proposed than that of being dictatorial, that alone would have prevented success. No man is exactly willing to be benefited under compulsion. When it comes to "Taxation without representation," it is too much for even a great corporation like the Pennsylvania Railroad to enforce. If in the beginning the company had called a meeting of employes and made a fair contract with two parties to it, instead of formulating a plan of their own and virtually demanding its acceptance, success would probably have been assured. It would have been much easier to have agreed upon a plan then than now. We do not believe the last sentence in the company's circular was at all necessary.

Cutting the Tariff by Indirection.

A recent decision of the Supreme Court has reversed the practice which the Customs officials of the Government have followed during the past two years and a-half, in levying duties upon the cartons or inside coverings in which a great variety of merchandise must be packed to become merchantable. The decision emphasizes the disadvantages which are liable to follow ill-advised tariff legislation. Among the tariff changes which went into effect in 1883, was one providing that duties should not be levied on the coverings or packages in which merchandise was shipped. The Customs officers interpreted this change in the law to apply to outer coverings or packages only, such as packing cases, crates, etc. Accordingly the Government continued to regard the cost of the paper box, for instance, in which a dozen pocket-knives or files have to be packed in order to make them salable by dealers, as representing a part of the cost of the knives or files, quite as legitimately as that of the handles or blades.

This interpretation of the law was sanctioned by Judge Folger, then secretary of the treasury, and one of the most accomplished jurists in the country, and was sustained by Judge Wallace of the United States Circuit Court, proving that the views of the officials were not without basis.

The Supreme Court decision shows clearly enough that this particular tariff change was ambiguous and debatable, and its promulgation makes an important cut in the tariff on a very large class of goods. Of course, the Supreme Court, in theory, only declares the law as it is, and the quarrel of American manufacturers, who desire to have the tariff sustained (or reduced plainly and intentionally, if at all), must of necessity lie with the congress which enacted the law changing it.

The immediate effect of the decision will not stop with lower duties on a wide range of merchandise for the future. It exposes the Government to the necessity of "refunding" many millions of dollars so collected, to a number of importers who undoubtedly added the amounts now claimed to the cost of their goods at the time, and to the coterie of sharp lawyers who put them up to the plan of claiming and collecting them.

Reaction Against Great Iron-clads.

A significant article in the London *Times* points to a growing opinion in England that the monster iron-clads, of which the Inflexible is a type, are not to be of much further use in naval warfare. The fact seems to be that it is easier to build guns that will pierce the heaviest armor plate, than to thicken the plate to resist the shots, and aside from this is the fact that a small torpedo boat may destroy the most powerful armor-clad. In view of developments in torpedo warfare, it may almost be concluded that the United States has lost nothing in waiting before building a navy. While there is no probability of a return to the old "wooden walls," there is reason to believe that the war vessel of the near future may be a swift and comparatively lightly-armored boat, and that the torpedo boat is to form an important part of the naval armament. The *Times* says:

One of the difficulties connected with armor-clad ships is that of making them efficient for every purpose. The Constructive Department of the Admiralty laid before the late Board a design for an armor-clad having the enormous displacement of 22,000 tons. It needs hardly to be said the official staff did not recommend the design for adoption. But it served to show what was necessary to meet the criticisms directed against defective points in ships of war. A vessel designed on this scale was the nearest possible approach to perfection; but she was too costly. Every ship of less size was open to objection, in view of existing weapons and modes of warfare. A vessel costing less than a million and a half for hull and engines was shown to be vulnerable against means of attack capable of being practiced on the high seas, without referring to ground mines, against which even the vessel of 22,000 tons would be insecure.

This is interesting, and ought to be instructive, as showing what form the question is assuming in England, where it has received the closest possible attention.

In the article by Robert E. Masters on Locomotive Spark-arrester Castings, which appeared in our issue of Feb. 27, by a typographical error, the word *core* is several times printed instead of *cone*. The reader will, by a little consideration, readily detect the error.

Fink Seeking New Pastures.

A Western correspondent writes us, referring to the bogus oil-man Fink:

You have pretty nearly broken up his "business" in the machinery line, but he has lately been working different leads, for instance, glass-works and distilleries. At last accounts he had struck the coal measures level and was working the miners. He has been disporting himself in Florida recently. He was at a New York city hotel last week.

According to the U. S. Minister to China, a marked change of policy has occurred on the part of the Chinese Government regarding the introduction of railroads into that country. The emperor and viceroy have just inspected the operations of a miniature railroad, working on the American plan, with every department represented in the model. They expressed themselves highly pleased, and propose to inaugurate a policy favorable to railroads and railroad-building forthwith.

Literary Notes.

INDICATOR PRACTICE AND STEAM-ENGINE Economy. With plain directions for attaching the indicator, taking diagrams, computing the horse-power, drawing the theoretical curve, calculating steam consumption, determining economy, locating derangement of valves, and making all desired deductions; also tables required in making the necessary computations, and an outline of current practice in testing steam-engines and boilers. By Frank F. Hemenway. Fully illustrated. New York: John Wiley & Sons. 1886. Price, $2.

The above is the title of a handsome volume recently issued. It contains 180 pages, with a number of illustrations, and is fully indexed. Probably the most suitable presentation of its aims to our readers will be found in the words of the author as expressed in the preface, quoted below:

"During the past two years I have written several short articles for the AMERICAN MACHINIST on the subject of the indicator-diagram. In these there was not much attempt at connection, or intention to cover more than a few points as they came up from time to time. As an outcome of the appearance of these articles I have received many letters of inquiry, especially from engineers in charge of steam-engines and boilers of various classes. These letters, very frequently leading to considerable correspondence, have largely guided me in the preparation of this work; it seemed a fair presumption that they indicated what would be acceptable to others similarly situated.

"It has been my aim to present the subject comprehensively enough to enable any engineer to apply the indicator to his engine, take the diagram, and make all necessary calculations from it. The endeavor has been to use no terms except such as are generally understood or fully explained, and no mathematical demonstrations are given or are required that involve the use of anything but simple arithmetical calculations.

"As one of the most important ends the indicator can serve is to point out how to bring about economy of steam-consumption, its use has been considered in connection with steam-engine economy; there seems to be no rational way of dividing these subjects, even if it were desirable.

"A separate chapter has been devoted to locomotive-engines, because while the general

matter applies to these in common with other steam-engines, there are some features peculiar to locomotive-indicating.

"All the engravings, both of diagrams and methods of obtaining drum-motion, were made expressly for this work. What was suitable of the matter referred to as written for the AMERICAN MACHINIST has been revised and used; the rest, comprising the larger portion of the whole, is now published for the first time.

"Fully believing that in the near future no engineer will be considered competent unless he has knowledge of the use of the indicator, I shall be satisfied if my efforts make the subject plainer to a few; or if in any degree they assist those who recognize that the indicator-diagram has become so thoroughly incorporated with the current literature of steam-engineering, that, aside from the intention or ability to use the indicator, every one interested in the steam-engine should learn to read the diagram."

HAND-BOOK OF USEFUL TABLES FOR THE Lumberman, Farmer and Mechanic. Containing tables of interest at six per cent., wages per month and week, board or rent per week, board, scantling and plank measure, cubic contents of square and round timber, cubic contents of round timber when squared, logs reduced to inch-board measure, standard contents of logs, wood measure in load and pile, cost of wood, cost of lumber, weight of grains per bushel, contents of granaries, bins, etc., capacity of cisterns, weight of seasoned lumber per 1,000 feet, weight of solids per cubic foot, liquors per gallon, wood per cord, length of nails and number in a pound, and other valuable tables, besides miscellaneous and useful information, etc. Philadelphia: Henry Carey Baird & Co., 810 Walnut street.

This will undoubtedly be found a very useful little book to all who have use for such tables, and the number who will not find them of service will be few. It is a book of 186 pages, and sells for 25 cents, postpaid.

"Calvert's Mechanic's Almanac for 1886," contains rather more than the usual amount of reading matter of interest to mechanics. This almanac is a standard publication, and good discretion is used in the selection of matter which, we should think, will be found worth more than its price to every mechanic. It is sent, postpaid, for seventeen cents, by J. A. Gardner, 307 Floyd street, Brooklyn, N. Y.

We have received the report of proceedings of the American Railway Master Mechanics' Association, held at Washington, last June. It makes a pamphlet of 185 pages, and is well printed and illustrated. These reports become more valuable every year, giving as they do current practice in locomotive improvements, and the results of different construction and management.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(104) G. S., Grand Rapids, Mich., asks: Will you give me information for getting the correct diameter of a worm-wheel? *A.*—You will find very full directions in the AMERICAN MACHINIST of May 30, 1885.

(105) S. H., Cleveland, Ohio, writes: I have got two lines of shafting which cross at an angle of 45°. The shafts are on separate floors of a building. Can I connect and drive them by a belt, and how? *A.*—This matter is illustrated and explained in the AMERICAN MACHINIST, of August 12, 1882.

(006) S. P. U., ———, writes: In the AMERICAN MACHINIST of Jan. 17, 1885, the statement is made that a grindstone should run "just fast enough to cause the drops of water to begin to fly." Now, how shall I determine the exact speed at which that occurrence takes place? *A.*—Turn the stone by hand until the required speed is obtained, then count the number of revolutions made per minute. With a 36" stone the speed is about eighty-eight turns, or a surface velocity of 829.22 feet per minute. From this, the speed required for any size of stone may be easily determined.

(107) J. J., Philadelphia, Pa., writes: I have an engine 14" × 42"; boiler pressure, 70 lbs.; cut-off at half stroke; the steam pipe is 4"; exhaust pipe, 6". I wish to place a four-pound weight on exhaust for heating building. Can you tell me what back pressure I have at end of stroke, and how to calculate it? *A.*—The supposition is, that the exhaust opens enough before the end of the stroke, so that the back pressure at that time is not more than about 5 lbs., and that that is very soon reduced to one or two pounds. This would depend largely upon the valve motion and the speed of engine. We do not understand what you mean by "a four-pound weight on exhaust." A weight of four pounds acting direct on a 6" back-pressure valve will increase the back pressure only a small fraction of one pound.

(108) W. L. H., Wallula, W. T., writes: 1. Can I grind globe and angle valves by hand so they will not leak? *A.*—Yes, by making a set of mills and burs which will fit different sizes of valves; also make a set of female mills which will work the valves proper without detatching from the stems. Tools for this purpose used to be in the market, but have gone largely out of use since the rubber valve and detachable valve-seat has come into use. 2. I have charge of a boiler on which is a pop safety-valve, which has never to my knowledge, been repaired or tampered with. The valve raises at 100 pounds per steam gauge, but will not close again until the pressure has been reduced to 85 pounds. What is the reason of this? *A.*—It may be caused by excessive friction in the valve-stem connections, or it may be owing to the faulty construction of the valve. 3. Can the valve be made to close after the pressure has been reduced three or four pounds. *A.*—Probably it can be done by sending it to the builder for repairs.

(109) B. U., ———, sends sketch showing steam-engine driving mill. The mill is driven from a shaft to which the engine belts. In one instance the mill is set so that pull of the belts from both engine and mill are in one direction; in the other instance so that the pull of belts is to an extent in opposite direction. The first position of mill he calls *B*; the second, *A*. He asks: 1. Will not the arrangement as at *A* be best, and why? *A.*—The location designated as *A* is a little the best, mainly that the opposite pull of the belts will relieve the friction of shaft a little. 2. In boiler setting, the general plan is to leave a deep space from bridge wall to end of boiler. Is it not better to fill this up partly? *A.*—A very common practice is to leave a combustion chamber behind the bridge wall, then behind that to fill up to ten or twelve inches of boiler. 3. What is the use of a combustion chamber? Can smoke be burned in it? *A.*—The purpose of the combustion chamber is not to burn smoke, but to burn the escaping gases, and prevent the formation of smoke.

(110) E. E. H. asks why iron will burn in a blacksmith's fire instead of melting, and why does it not do the same in a cupola? *A.*—Iron burns, to a certain extent, when it comes from a cupola into the air, as may be noticed when the tap-hole is open at the time the iron begins to come down. The iron does not fly off in burning sparks until it comes into such a position that it is blown into small particles by the blast. Then it is in such a condition that it can unite very fast with the oxygen of the atmosphere, and the vivid sparks fly off. In a smith's fire there is but a small body of iron exposed to the action of the fire, and the moment a part of it becomes melted it is seized by the blast which comes from below, and very quickly unites with oxygen. If, in the smith's fire we bring in the blast in such a position and quantity that the iron is sufficiently heated without coming in contact with an excess of oxygen under comparatively high pressure, then we can successfully melt, without burning, a piece of iron in a blacksmith's fire. 2. How is the best way to tell when iron is just at the right heat for welding? *A.*—By experience. 3. Are taps milled before or after the thread is cut? *A.*—After. We will soon give you some information regarding your other question.

(111) J. H. G., Leadville, Col., asks: 1. How much would 200 feet of 2" steam pipe expand with steam at 100 pounds pressure? *A.*—About 3¾". 2. How are hand-saws tempered? *A.*—By heat and pressure. 3. Will heating them draw out the temper? *A.*—Yes. 4. Where are the largest silver-smelting works in the United States, or the world? *A.*—We cannot positively answer the question, but presume they are in the silver region of the West. 5. This altitude is ten thousand feet above the sea level. How far can water be raised here, with a suction-pump? *A.*—Probably 15 to 18 feet. 6. Is there anything which will prevent boilers from scaling when lime-water is used? *A.*—By a judicious use of the blow-off much of the lime may be got rid of. A heater will also help overcome the difficulty. In case it is decided to use a chemical, an analysis of the water should by all means be made before beginning the use of "boiler compounds." If, as is usually the case, the lime is a carbonate, a form of tannic acid will be of value. If the lime is present as a sulphate, some form of soda will be of use. Some people claim that tannate of soda will help both forms of boiler complaint. 7. What are the average wages of the engineers of sea-going vessels? *A.*—The wages paid a marine engineer should, and probably does, depend upon the individual skill and value of the particular man in question. 8. According to science, what would be the effect on the earth if the sun were to stop, say ten minutes, about noon? *A.*—We do not undertake to say. We hope the experiment will not be tried. 9. What is your limit to questions for any one to ask at one time? *A.*—We have no limit, provided that the questions are common-sense ones, pertaining to our specialty.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Power measured.—F. Van Winkle, 22 Cortlandt, N. Y.

Alt, Mechanical Engraver on Wood, 318 B'way., NY

T. M. Parker, Steel Stamps, Stencils, Hartford, Ct.

J. Clayton, Air Compressors, Rock Drills, 43 Dey st, NY

Edw. Sears, Wood Engraver, 48 Beekman st., N. Y.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Tack, Wire and Shoe Nail Machinery. Wm. A. Sweetser, Brockton, Mass.

Tack and Wire Nail Machinery, made by the Willets Mfg. Co., Providence, R. I.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Tools, Hardware and other specialties made under contract. American Machine Co., Philadelphia, Pa.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., NY

Patent Attorney and Expert. Machine designs and details. Wm. H. Weightman, 82 Astor House, NY

Foot-power Machinery, for workshop use, sent on trial if desired. W. F. & Jno. Barnes, Rockford, Ill.

Lyman's Gear Chart. How to Lay Out Gear Teeth. Price, 50c. E. Lyman, C. E., New Haven, Conn.

Improved Labor-saving Upright Drills, 20-in. to 36-in., inclusive. Currier & Snyder, Worcester, Mass.

Engine Lathes, Hand Lathes, and other fine tools, Assortment large; prices low. Frasse & Co., 62 Chatham st., N. Y.

10,000 names of Manufacturers in N. Y. and N. J Steam Users' Directory (in press); send for circular. J. N. Mills Pub. Co., 30 Vesey st.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See Feb. 13, p. 12. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

E. Merritt & Co., Brockton, Mass., established 1859, only manufacturers of a complete line of Tack and Nail Machinery. Send for circulars.

Files recut without drawing temper, about one-half usual prices; samples recut free; prices on application. The Acme Co., Collinsville, Conn

"Complete Practical Machinist," $2.50; "Mechanical Drawing Self-taught," $4. Books for workmen. Joshua Rose, Box 3306, New York City.

Bound Volumes of the AMERICAN MACHINIST for the years 1880, 1881, 1882, 1883, 1884 and 1885. These volumes are strongly bound in cloth, and will wear well. Price $3.50 each; express charges additional. AM. MACHINIST PUB'G CO., 96 Fulton st., N. Y.

"Locomotive Engine Running and Management." By Angus Sinclair. Gives full directions about handling and repairing locomotives; instructs how to design valve gear and set valves; Westinghouse air-brake explained by aid of engravings. Price, $2. For sale by Angus Sinclair, 175 Dearborn street, Chicago, Ill.

Patent Binders for the AMERICAN MACHINIST, holding a complete volume (52 issues), simple, neat, durable. Price $1, prepaid, to any part of the United States by mail. To Canada or foreign countries the price will be 75c.; purchasers pay express charges and customs duties. AM. MACHINIST PUB'G CO., 96 Fulton st., N. Y.

Every young man who aspires to be either a mechanic, merchant, or manufacturer, owes it to himself that he become thoroughly familiar with the writings of Chordal. John Wiley & Sons, 15 Astor Place, N. Y., have issued a new and enlarged 12 mo. edition of "Extracts from Chordal's Letters." Handsomely bound in cloth, with over 50 illustrations. Price, $2. Discount of 25 per cent. on orders for five or more copies.

MANUFACTURES.

The Athens (Ga.) Ice Company propose to increase their plant.

The Fairbanks Scale Co., Buffalo, N. Y., intend to entirely remodel their factories.

The Wiley & Russell Mfg. Co., of Greenfield Mass., are building an addition to their factory.

The Brown Mfg. Co., Dover, Me., contemplate an enlargement of their woolen mill.—*Industrial Journal.*

W. B. Dunning, Geneva, N. Y., has made further shipment of his heating boilers to Berlin, Germany, also to Manchester, England.

Thomas H. Dallett & Co., 3015 Chestnut street, Philadelphia, Pa., have removed their works to 13th and Buttonwood streets.

McGinty's machine shop, at Athens, Ga., which employed 60 men, will be rebuilt at once, and he will put in new and improved machinery.—*Commercial Bulletin.*

The Providence Steam Engine Company, Providence, R. I., are unusually busy, running until nine or ten o'clock at night. Their present drive is mainly on the improved Greene engine.

The Abendroth & Root Mfg. Co., 28 Cliff street, New York, has issued an illustrated circular of their new class "C" boiler, giving full description of its construction and arrangement.

D. Frisbie & Co., 481 North Fifth street, Philadelphia, have opened a New York agency at 49 Dey st., in charge of Geo. C. Tewksbury, for the sale of their clutch-pulleys, couplings and elevators, the latter mainly operated with the Cowdrey engine

The Beloit Plow Works, of Beloit, Wis., are considering a proposition to move to St. Paul, Minn.

The Northern Pacific Railroad Car Shops, at St. Paul, Minn., will start April 1 with 150 hands. Both shops and machinery are new.

The Fischer Foundry and Machine Co., Pittsburgh, Pa., successors to the late firm of Fischer, Thomas & Co., are constructing a large foundry.

Poole & Hunt, Baltimore, Md., are building a new boiler, smith and erecting shop. They are also enlarging their machine shop.

The Northern Pacific Railroad will erect a round-house and machine shop at Tacoma, Wash. T., but it is uncertain when work will commence. Plans have already been made for the buildings.

The Dixon Crucible Co., of Jersey City, N. J., who manufacture nearly 1,200 different styles of lead pencils, report the business of their pencil department for the past six months as 20 per cent. larger than the corresponding six months of the previous year.

The Osgood Dredge Co., Albany, N. Y., has issued a seventy-page pattern-list, which comprises a complete memorandum of parts and pieces of the dredging, excavating and hoisting machinery made by them. The pieces are described and conveniently designated by letter and number.

The Minnesota & Northwestern Railroad will erect a round-house and repair shops just outside the city limits of St. Paul, Minn., upon twenty-five acres of land given them for that purpose. No plans for the shops have yet been made, but some of the heavy machinery has been ordered. From 100 to 200 men will be employed.

The Milmo Cotton Co., 295 Church street, New York, are manufacturing the Norris pulley cover, which is made of alternate layers of elastic rubber and canvas. It is made 2" to 4" wide, contains four layers of rubber, three of canvas, and is cemented together; one end of the cover is riveted to the face of the pulley.

The St. Paul, Minneapolis & Manitoba Railroad will erect new machine shops somewhere on their line. They will not enlarge their shops at St. Paul. None of the machinery has yet been purchased, nor has the location of shops been determined. This road will form a close connection with the Chicago, Burlington & Quincy, which will enter St. Paul this spring, and there are rumors of a consolidation.

Otis Brothers & Co., Yonkers, N. Y., favor us with their large and elegantly-bound, printed and illustrated catalogue of elevators of all kinds, steam hoisting and hydraulic hoisting machinery, etc. The engravings of modern hoisting machines are set off, in nearly every instance, by their ancient prototype, made on a reduced scale, making illustrations both instructive and amusing. Brief descriptions accompany the engravings, and several pages are required for the names and location of parties using the Otis machinery.

The E. G. Brook Iron Company, of Birdsboro, Pa., will build steel works in the spring. The Roane Iron Works, of Chattanooga, Tenn., H. L. Chamberlain, president, contemplate converting their works into a great steel plant. They have also decided to adopt the Bessemer process of steel making. James M. Hall, Richmond, Me., will commence work at once upon nine new ice-houses. Six will be 300x30, and the remaining three 200x30. Besides the steam works, elevators, and other machinery used in the houses, about 1,000,000 feet of lumber and over ten tons of nails will be required in their erection. F. M. Richmond, Livermore Falls, Me., has commenced to fit up a large wooden building into which he will put machinery for all kinds of wood-working. Expects to be ready for operations next summer. Chas. Mengle, Jr., of Louisville, Ky., will erect a large brick planing mill on the south side of Kentucky street, between Tenth and Eleventh streets, Louisville. G. W. Russell, Norway, Me., will establish a large new shovel-handle manufactory in Wilton, Me.—*New Enterprises.*

The Pawtucket (R. I.) Manufacturing Co., are adding to their facilities for building bolt and nut machinery. The Harris Mfg. Co., Phenix, R. I., are adding to their machinery. The Windermere (Conn.) Mills have been purchased by New York parties, and will be started soon. The shipyards along the Delaware river have recently received numerous orders for the construction of both coast-wise and river tonnage, and expect to be actively employed throughout the year. Claus Spreckles has just placed an order in Philadelphia for the construction of two large steamships to ply between San Francisco and Australia. The American Tube and Iron Co., at Middletown, Pa., are building several new furnaces and a number of threading machines for the purpose of getting out pipe more expeditiously. The mill is now turning out about 150 tons of pipe every twenty-four hours, and they expect to increase their capacity to 200 tons very shortly. The Baldwin Locomotive Works, at Philadelphia, have received orders for forty locomotives, and expect additional orders shortly. They started up on Monday, with a largely increased force of workmen, and changed their working hours from eight to ten per day. The Industrial Works, of Dushore, Pa., are very busy, having orders ahead to last three months. They talk of building an addition to their machine shop in the spring. The moulders at Morris & Co.'s and Marshall & Co.'s foundries, Pittsburgh, Pa., have been granted the advance of ten per cent.—*Boston Commercial Bulletin.*

Machinists' Supplies and Iron.

NEW YORK, Feb. 25, 1886.

The market has ruled quiet, and without commentable change.

Iron—In American pig the requirements of buyers have been moderate, and the market is steady. We quote Standard Lehigh and North River brands at $18 to $18.50 for No. 1 X Foundry, $17 to $17.50 for No. 2, $16 to $17 for Grey Forge, all tidewater delivery.

Copper—Improved demand; upward tendency in prices. Lake, 11.40 cents; Arizona, 10.50 cents.

WANTED

"Situation and Help" Advertisements, 30 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

A mechanical draftsman wants outdoor employment in connection with drawing. Address, Dirigo, AM. MACHINIST.

A practical draftsman, pattern-maker and machinist is open for an engagement. Address, Good Reference, AM. MACHINIST.

Wanted—A first-class pattern-maker and lathe hand. Address, McEwen Bros. & Co., Lim., Ridgway, Elk Co., Pa.

Wanted—A grinder and polisher on general machinery; must be a good workman and of sober habits; steady employment and good pay guaranteed. Address, T. E. J., AM. MACHINIST.

Wanted — A first-class practical foundry foreman; one willing to undertake the castings by contract preferred; output 50 to 60 tons per week. Address, with references, Sigma, AM. MACHINIST.

Wanted — Travelers selling goods to machine shops and dealers through New England can make satisfactory arrangements on commission, by addressing Box 4, AM. MACHINIST.

Situation wanted by a first-class pract. and theoret. mech. draftsman; good experience in mechanical and structural work; best references. T. 304, P. O., Philadelphia.

Wanted-A few first-class workmen on mathematical, electrical and philosophical instruments; good wages and steady work to competent men. Address, with reference, James W. Queen & Co., 924 Chestnut street, Philadelphia.

Wanted—A brass moulder who thoroughly understands mixing metals; must be sober and quick worker, and come well recommended; location Western Pennsylvania; work, railroad castings. Address X, AM. MACHINIST.

Wanted—An assistant foreman in machine department of a locomotive works, west of N. Y. Must thoroughly understand above class of work. State wages expected. Address Locomotive, AM. MACHINIST.

Wanted—Position as supt. of machine shop and foundry; experienced in grist-mill, saw-mill, agricultural machinery, estimating on same, and doing work by improved methods; fair draftsman and practical foundryman. A1 reference address John B. McLaren, Lansing, Mich.

Wanted—A foreman for carpenter shop where 20 to 25 men are employed manufacturing mowers, reapers, binders and plows; must be thoroughly acquainted with machinery and all the latest methods of doing work, and competent to manage men to best advantage. Address with references, stating age and salary expected, Frost & Wood, Agricultural Works, Smith's Falls, Ontario.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion.

The Crescent Steel Tube Scraper is king. Crescent Mfg. Co., Cleveland, Ohio.

Light mach'y of all kinds built at short notice. Pennington & Mills, 8 Dey st., Jersey City Heights, N. J.

Special tools and machines for mfg. designed and built to order; mechanical and Patent Office drawings. Weston & Smith, Syracuse, N. Y.

C. F. Langston & Co., 222 N. 5th st., Phila., can-makers' tools, presses, dies and special machinery built, rotary cutters made and ground.

Wanted, good second-hand foundry plant, cupola, crane, etc. Address, with description and price, Box 1127 Corry, Pa.

Wanted—Any party having second-hand Berryman heater for sale, to state size and cash price, must be in perfect condition. E. J. Moore, 49 N. 7th street, Philadelphia, Pa.

Patent or new Process; capital can be found for a practical and sound patent or new process. Address, with particulars, New Process, care of Thos. Veasey & Co., engineers, Finsbury Chambers, 78 Finsbury pavement, London, E. C., England.

Wanted, a good business man, with $10,000 to $15,000, to invest in and take active management of a lucrative manufacturing business situated in the South. For further information, address Box 3, AM. MACHINIST.

For Sale—The only boiler shop in a large mfg. district; a chance for the right party to do a good business. Satisfactory reasons for selling given on application to P. O. Box 461, Waterbury, Conn.

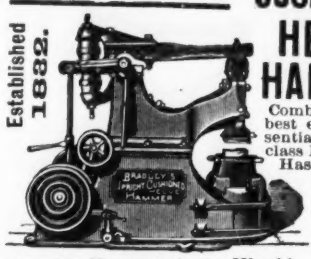
Patentee of a new positive motion four-valve gear for automatic engines wishes to arrange with a party who is in position to manufacture and put it on the market; has been tested. Address, Bucks, AM. MACHINIST.

For Sale—Shafting lathe, 28" swing, takes 20' between centers; treble-geared; 5 speeds on cone, for 2¾ belt; screw feed, but not screw cutting; also cylinder boring-bar 6" diameter, screw feed; cutter-head 9" diameter, 60' traverse. A. L. Henderer, Wilmington, Del.

Engine and Boiler—30 horse-power Buckeye engine; 42"x12' tubular boiler; all pipes and fixtures, including injector, heater and smoke-stack; the whole in good condition; in use about three years; to be replaced by larger engine, etc., of same make; can be seen in operation until Mch. 1. Address Geo. A. Barnard, 70 Astor House, New York.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

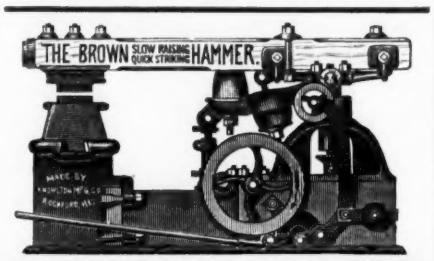
Established 1882.



Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the **World.**

BRADLEY & CO. Syracuse, N.Y.

THE BROWN HAMMER



STRIKES A BLOW WITH DOUBLE THE VELOCITY That it Raises the Hammer.
A NEW MOVEMENT! SEND FOR DESCRIPTION.
KNOWLTON MFG. CO., King St., Rockford, Ill

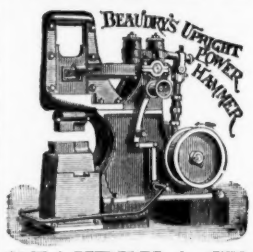
FOR SALE AT A BARGAIN.

A well established and good paying machine shop and foundry, including buildings, lots, machinery and stock, situated in Leadville, Col. The business will be carried on until sold, thus at once giving a profitable trade to the purchaser. Address,

A. FALKENAU,
Care of Dickson Mfg. Co.,
Scranton, Pa.

Only reason for selling, ill health.

BEAUDRY'S UPRIGHT CUSHIONED POWER HAMMER.



By far the Best. Blow Accurate, Powerful and Elastic

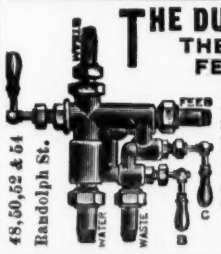
Will Increase the Profits of any Shop.

BEAUDRY & CUNNINGHAM,
BOSTON, MASSACHUSETTS.

H. W. JOHNS' ASBESTOS

Roofing, Building Felt, Steam Packings, Boiler Coverings, Fire Proof Paints, Cements, Etc.
Samples and Descriptive Price Lists Free.
H. W. JOHNS M'F'G CO., 87 MAIDEN LANE, N. Y.
175 Randolph St., Chicago; 170 N. 4th St., Philadelphia.

THE DUPLEX INJECTOR
THE BEST BOILER FEEDER KNOWN.



Not liable to get out of order. Will lift water 25 feet. Always delivers water *hot* to the boiler. Will start when it is hot. Will feed water through a heater. Manufactured and for sale by

JAMES JENKS & CO.,
Detroit, Mich.

48, 50, 52 & 54 Randolph St.

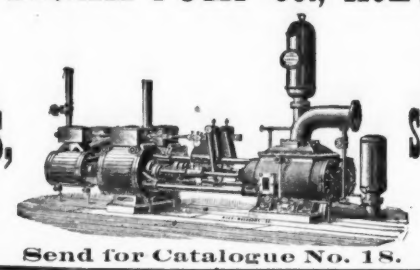
STEPHENS PATENT VISES

50 Per Cent. of time and labor saved by using this solid, strong, durable, quick-working Vise. Has the improved taper, pipe and other attachments. Sold by the trade. Send for circular.

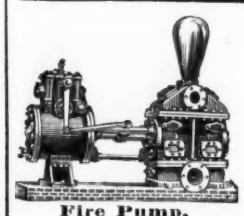
MELVIN STEPHENS, Prop'r, Office, 41 Dey St., New York.

THE DEANE STEAM PUMP CO., HOLYOKE, MASS.

BUILD WATER WORKS, ENGINES AND STEAM PUMPING MACHINERY.



Send for Catalogue No. 18.



Fire Pump.

GUILD & CARRISON,
BROOKLYN, N. Y.
STEAM PUMPS,
VACUUM PUMPS,
AIR COMPRESSORS.
SEND FOR CATALOGUE.

THE M. T. DAVIDSON IMPROVED STEAM PUMP

MANUFACTURED BY
DAVIDSON STEAM PUMP COMPANY.
WARRANTED THE BEST PUMP MADE FOR ALL SITUATIONS.
PRINCIPAL OFFICE, No. 77 LIBERTY STREET, N. Y.
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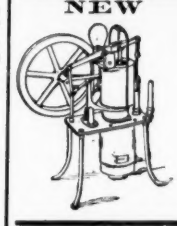

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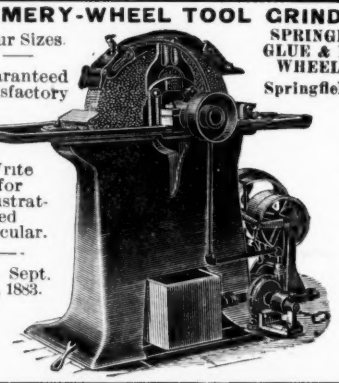

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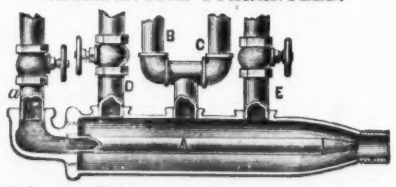

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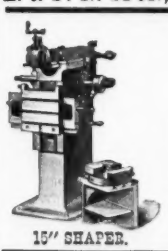

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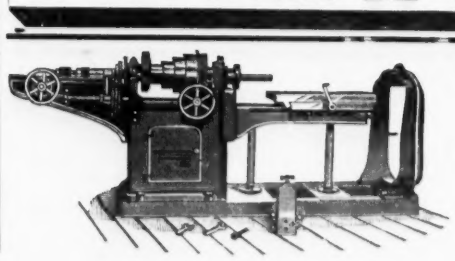

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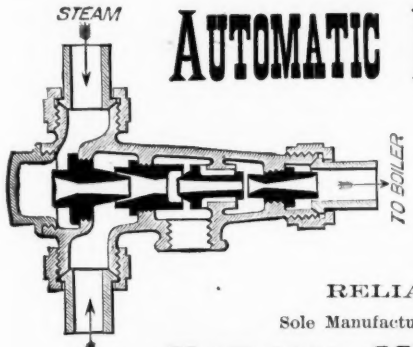

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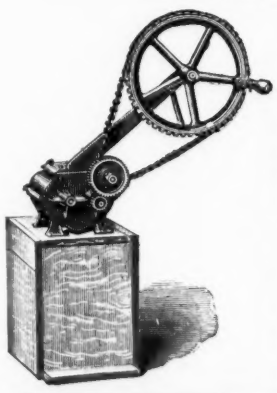

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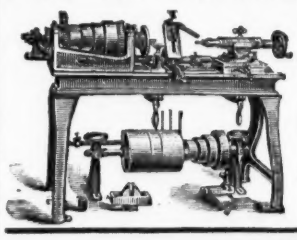

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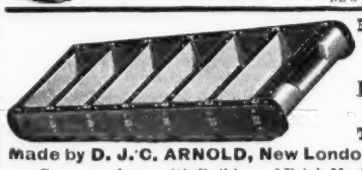

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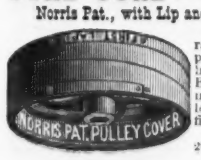

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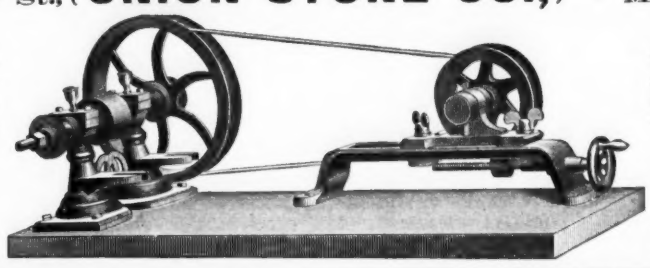

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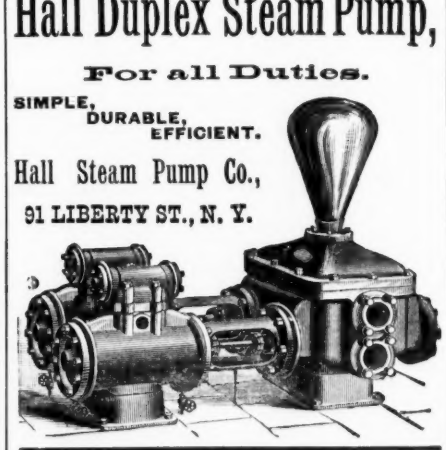

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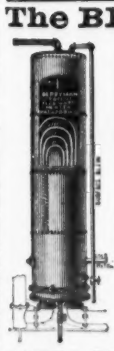

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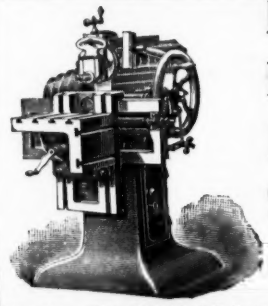

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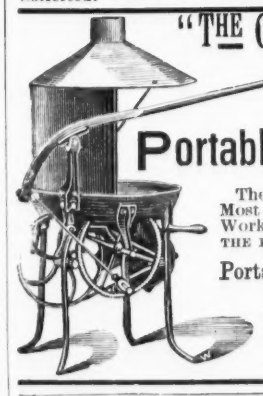

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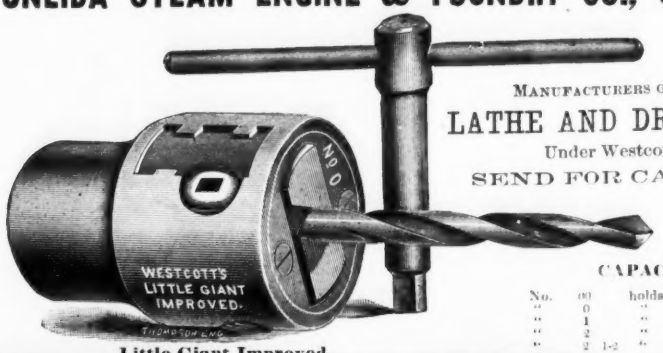

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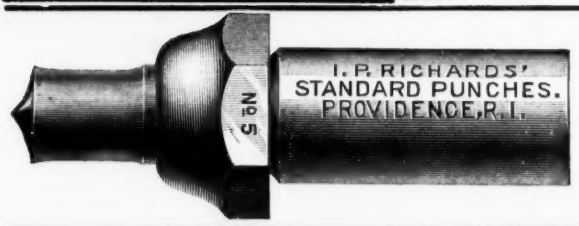

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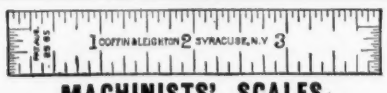

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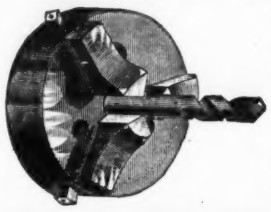

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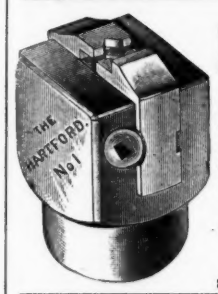

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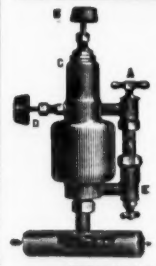

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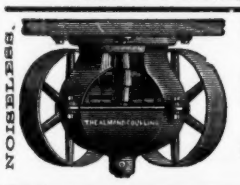

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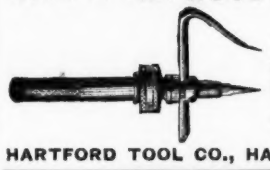

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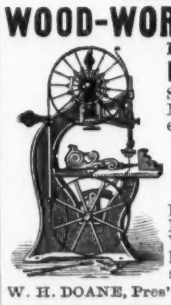

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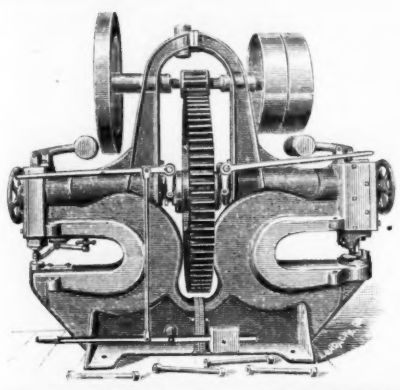

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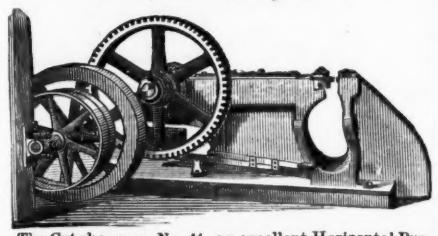

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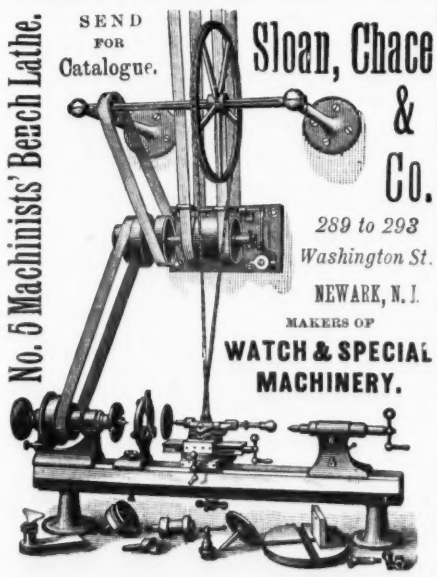

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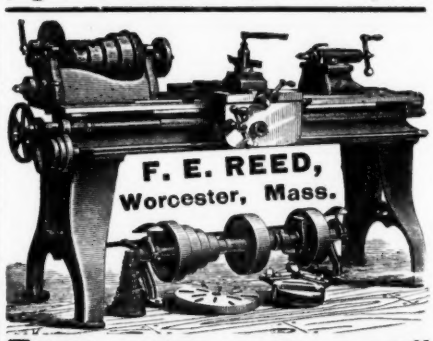

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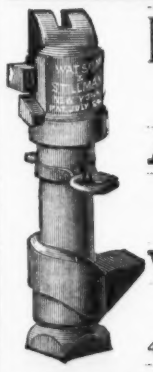

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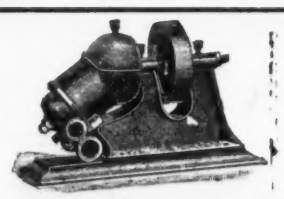

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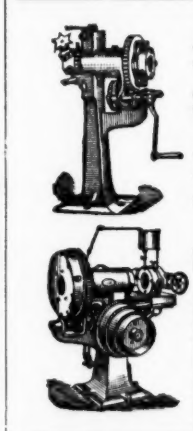

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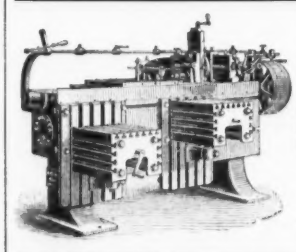

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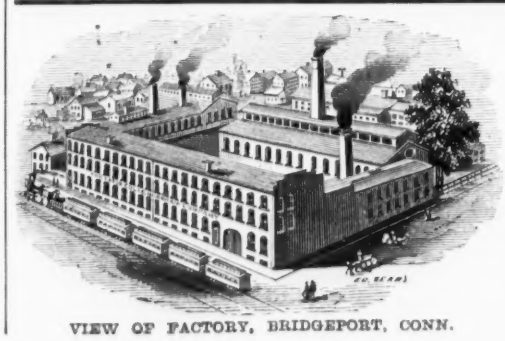

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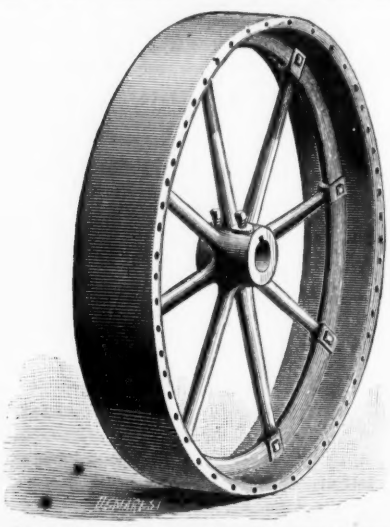

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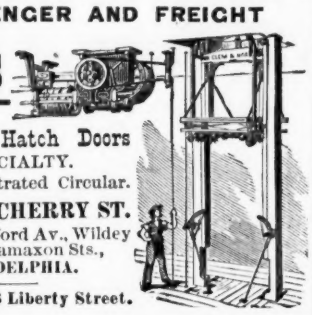

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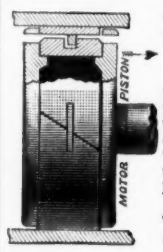

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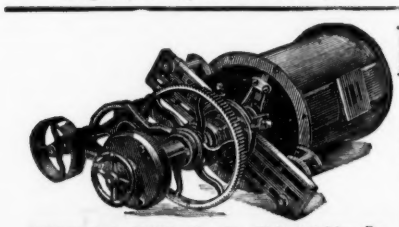

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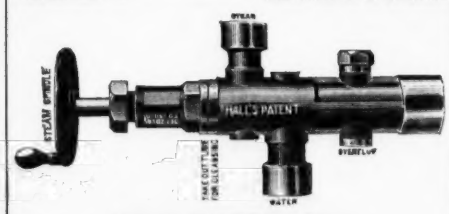

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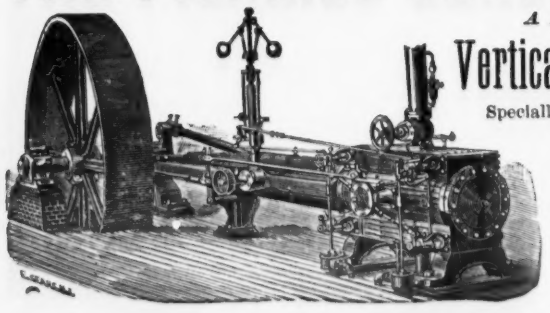

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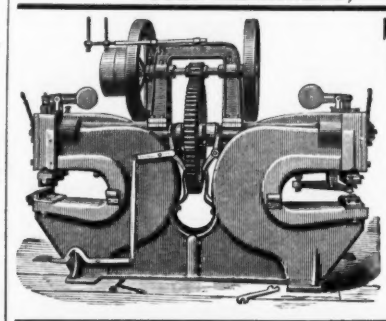

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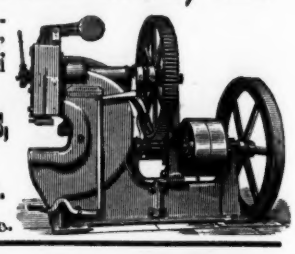

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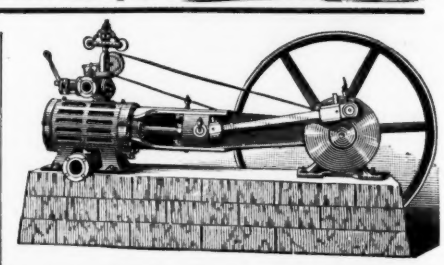

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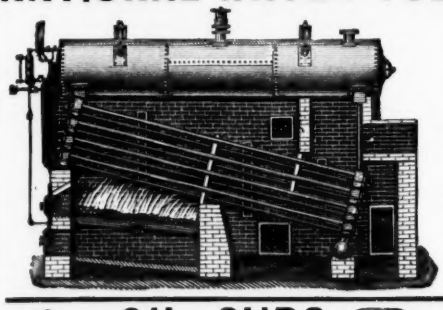

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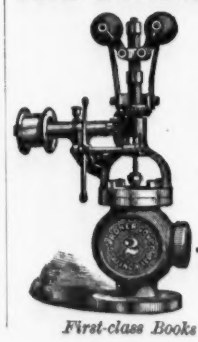

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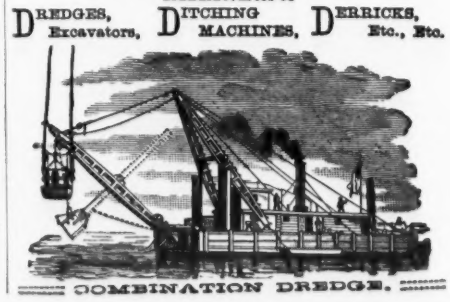

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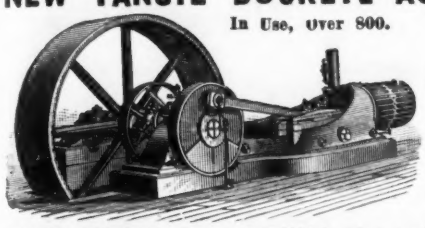

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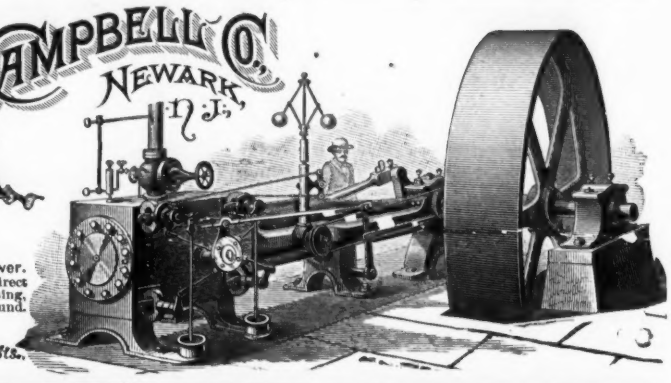

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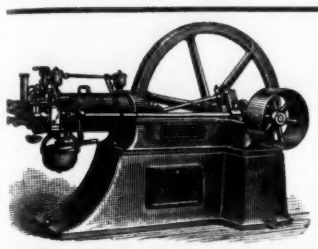

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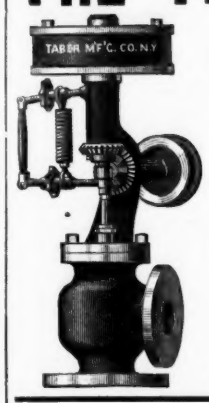

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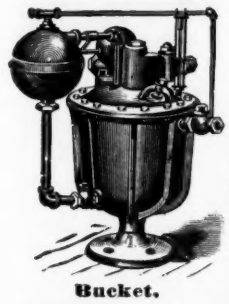

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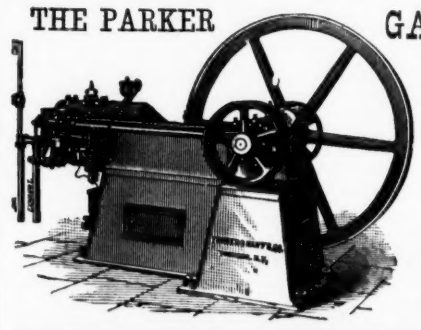

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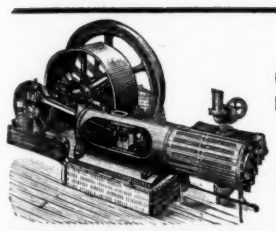

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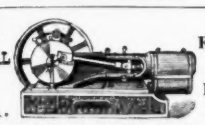

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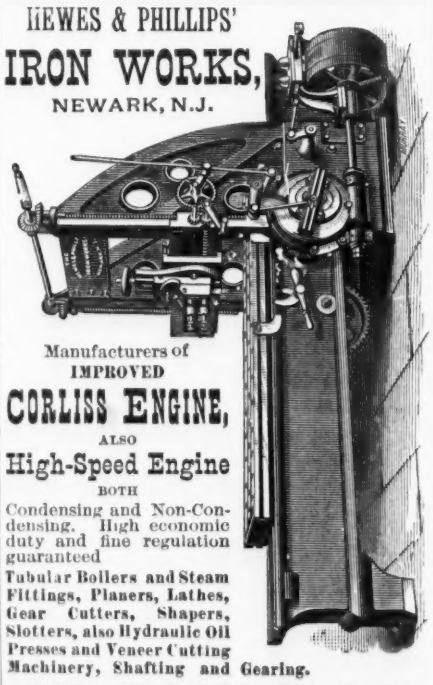

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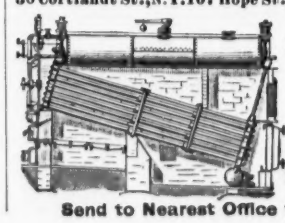

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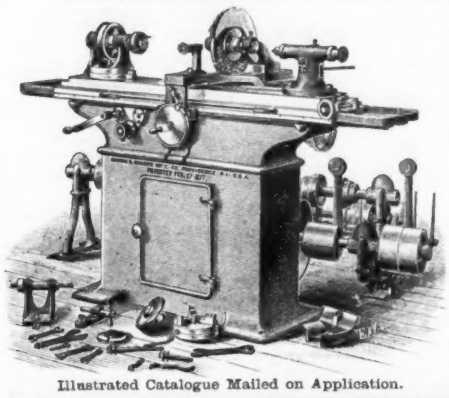

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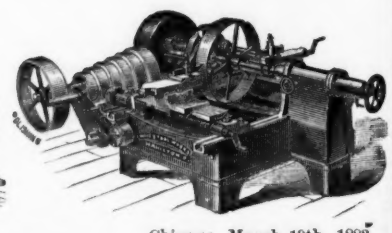

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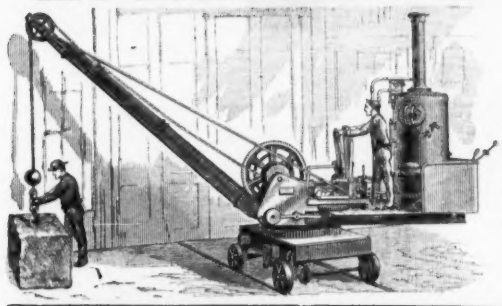

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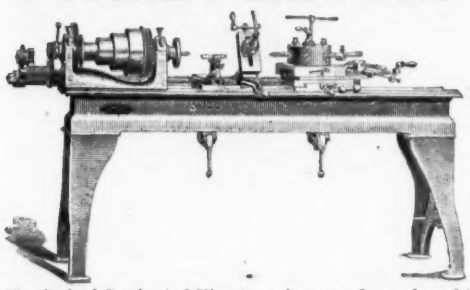

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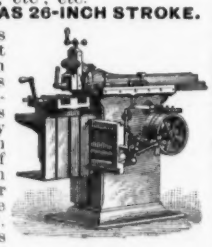

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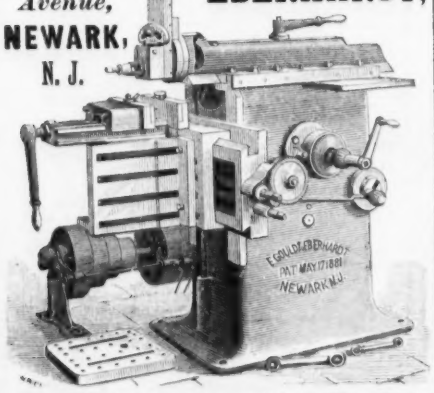

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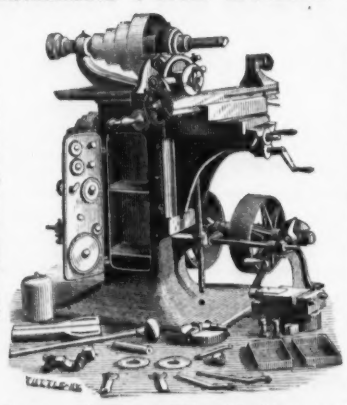

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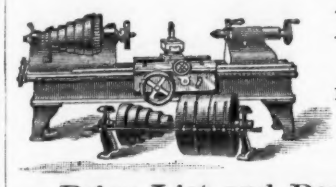

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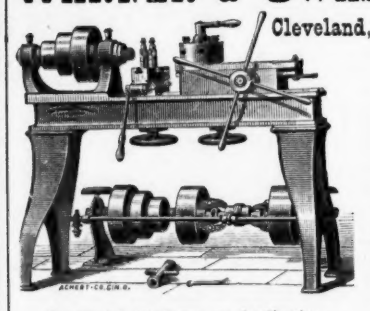

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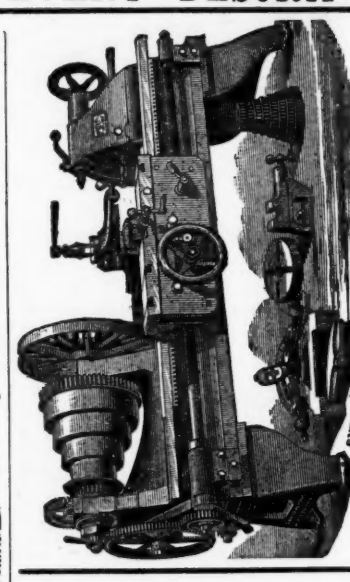

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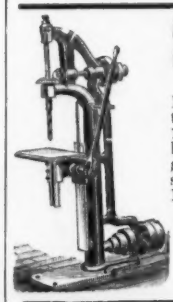

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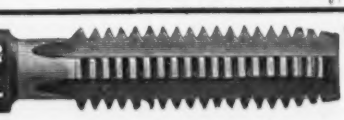

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